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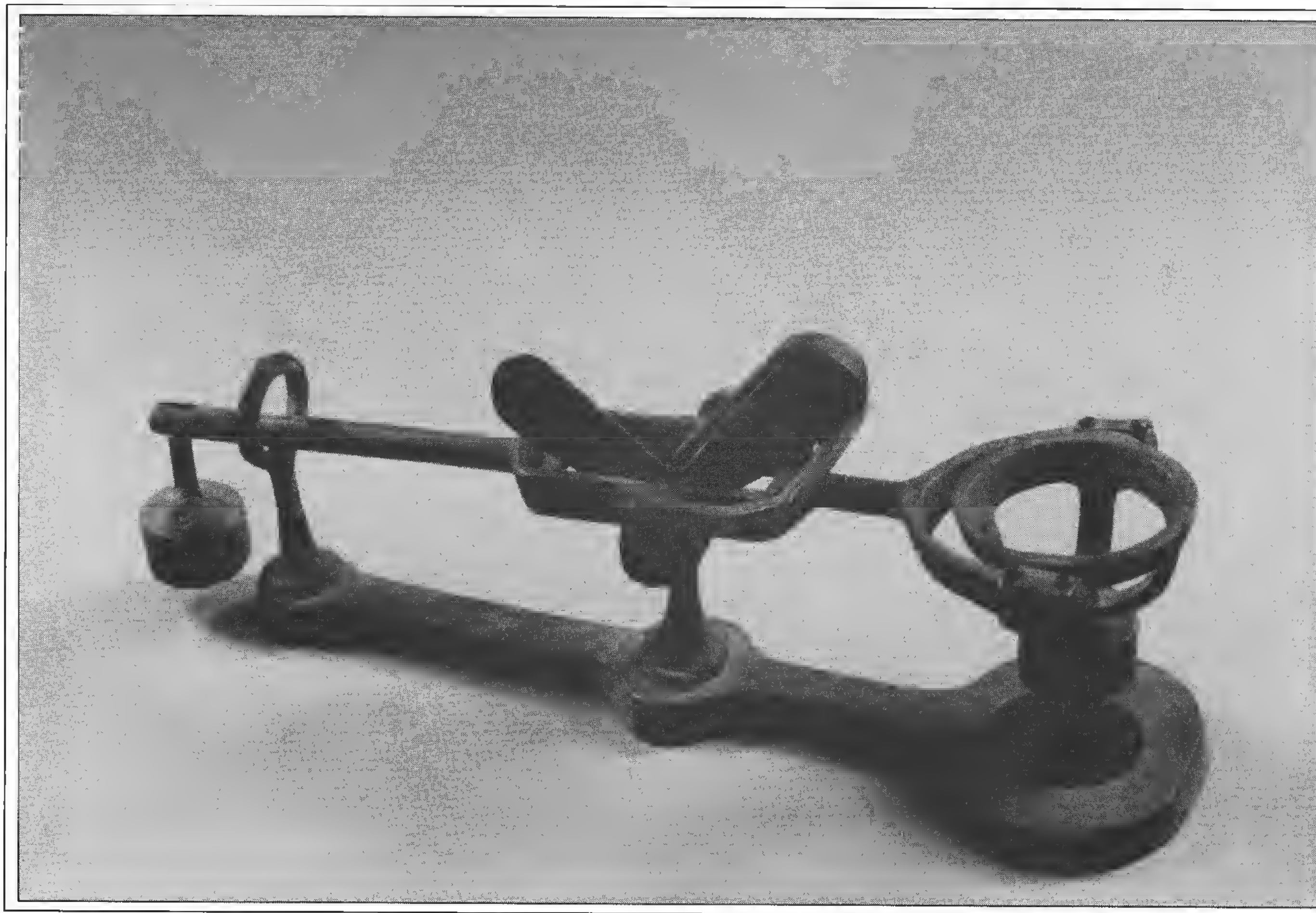

Cover Picture

This egg scale is the second scale that Betty Wright owned, and features in her article "How I started" on pages 1975-1976.

This egg scale was made by White Manufacturing Co, Gardena, California, of aluminium, with a base 8¼ inches (21 cm) long. It has three brass turn-over poises, marked 1 oz, 2 oz, and 4 oz. It has a free swinging aluminium cup held vertically by a lead lump below the cup. The hanging counter-poise is also of lead.

The manufacturer's trade-mark below the cup reads around the seal "WHITE MFG. CO. GARDENA, CALIF" and straight across, above the centre, "MADE BY".

There is a drawing of this scale on page 1281 of EQM, in the definitive article on American egg scales by Louis Costa, who gave a paper at the San Francisco Convention in 1989, which he lavishly illustrated with beautiful colour-photographs. He told Betty that this White was a rare one.

In principle this is a fixed-weight steelyard, with additional poises that only press on the beam when they are flipped towards the poise. When they are flipped towards the cup, they rest on the raised structure above the beam and add no weight. The principle of putting a heavy, free-swinging mass below the load is called 'Schickert's Principle'.

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How I Started

By B WRIGHT

In my teens I developed a desire to own what I now know as an equal-arm balance. Back then, I called it a "scale of Justice." It was the design concept that appealed to me. I did not think of it as a weighing instrument, just as an object I wanted but never found. When I married Frank, we acquired a house with a fire-place, and my thoughts were broadened to think the object of my desire would look nice on the mantlepiece.

In 1954 I visited a junk-shop in San Diego. On a shelf just below the ceiling sat a small equal-arm balance of what I assumed to be brass. I purchased it for $10, spent 3 days cleaning it, then brought it back here to Virginia where, indeed, it was a most attractive mantlepiece decoration.

Some months later the relative whom I had visited in California sent me an egg scale she had found in her father-in-law's barn. (See the cover picture.) Intrigued that eggs were weighed, I set it on a book-shelf next to the fire-place. Later in a local junk-shop I saw an equal-arm balance on a wooden base with a drawer containing a wooden holder fitted with knobbed weights. With a little give-and-take, I carried it out for $10. Moving up in both location and in price, I found in a local antique-shop a brass object that looked like a candlestick. The proprietor told me it was an English postage scale and I bought it for $15.

Identities blur after that. A few more scales went into the book-cases by the fire-place and two, gifts from friends, became plant-holders in the garden. When asked if I collected scales I realised I did, but I did not really think of it as a serious hobby, just as the well-controlled acquisition of interesting and decorative objects.

My loss of control began in England where I saw fascinating scales all over the place. At Grey's Market in Duke Street, London, I bought a tea scale. The proprietor told me that a society had been formed for people who collected scales. She did not have the address but directed me to Spinks in Jermyn Street where I picked up a flyer on ISASC and bought three scales.

When the first ISASC meeting was held in California in 1979, I flew out in a state of high excitement. I then had 50 scales. A lot, I thought. I had taken pictures of my vast collection and put them in an album along with a little description of each piece.

Until I went to California I had never met another scale-collector. The fact that I felt intimidated by the first collectors I did meet is understandable. They included Diana and Michael Crawforth, Bob Stein, the late Mort Wormser, Bill Doniger, Norman Sturgess and Ruth Willard, all possessors of large collections and of encyclopaedic knowledge. Not surprisingly, I was reluctant to show my little book. But, far from making me feel like a scruple among ton weights, everyone was friendly, helpful, encouraging and highly interested in seeing even my small collection. It was far from a great collection, but it included a person-weighing machine everyone flipped over and a postal scale for which Bob Stein immediately engaged in barter. (I held firm. I still have it and he still wants it.) Through the lectures and through conversation with other collectors I gained a wealth of information. I bought several scales at the auction following the meeting and Frank, who had not been too sure of the merits of collecting scales as a hobby, caught the fever and aided and abetted me.

The rest is history, a history to which new chapters are constantly added. My collection is still small compared to those of many ISASC members, being something over 500 scales. I still own

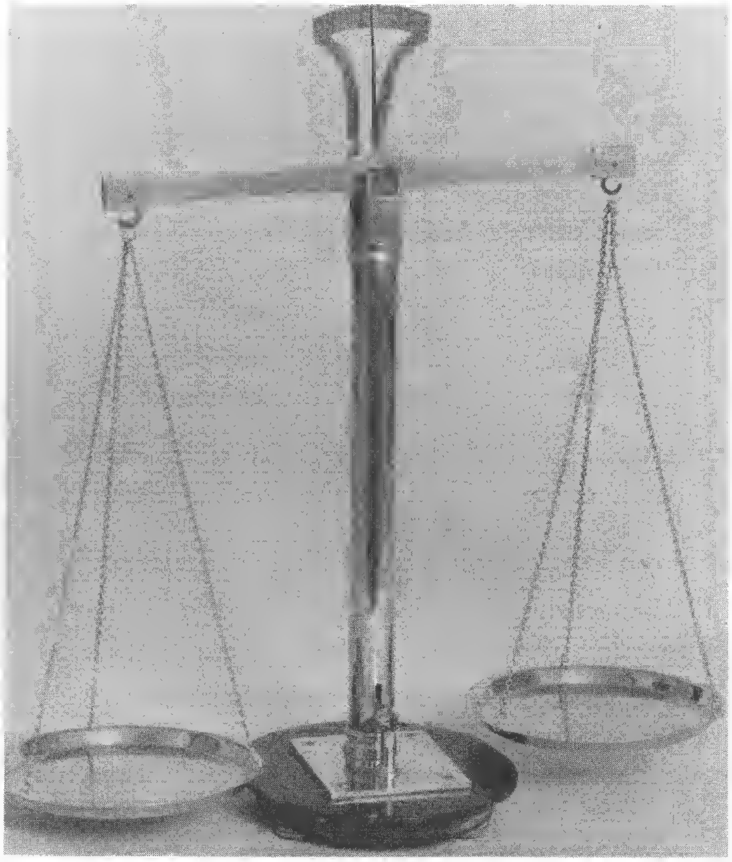


Fig. 1. Assay scale by Jacob Blattner. All brass on black-lacquered wooden base, with four wooden bun feet decorated with brass collars. Beam 11½ inches (29.5 cm) long, with square box-ends. Height 17½ inches (44 cm) with upward pointer, and a brass graduated arc indicating whether the load is over or under the mass of the weights. No numbers on the five graduation lines to each side of zero. Neat lever-lift operates a rod inside the pillar, to raise the plane bearing up to the knife-edges and start the oscillation of the beam. Weights missing.

Blattner: Advertisement in Edward's St. Louis Directory of 1866 lists Blattner as '*Mathematical, Philosophical (that is, teaching) and Optical Instrument Maker, Pine Street, bet. 3rd and 4th.*' Jacob Blattner was born in Berne, Switzerland, in 1812, came to St. Louis in 1839, and died there in 1888. Business moved to 220 N 4th St. in 1870. Passed business to son Henry Blattner and son-in-law Adams in 1878, as Blattner and Adams.

and take pride in my first acquisitions. The egg scale, now one of twenty-four, is by the White Manufacturing Co. of Gardena, California and, I learned, rare. The candlestick is, of course, by Robert Walter Winfield, and my collector's ego was fed by the appearance of an article on Winfield in the first issue of Equilibrium.

The equal-arm balance is marked *"J Blattner, St. Louis, Mo."* Only recently I learned from Eric Newman (a long-standing ISASC member) that Blattner came to St. Louis in 1839 from Berne, Switzerland and died in St. Louis in 1888. Eric sent me a copy of Blattner's advertisement in the 1866 edition of Edward's St. Louis Directory. It describes him as a *"Mathematical, Philosophical and Optical Instrument Maker."* Eric also told me that the name of the firm was changed to Blattner & Adams in 1878, so I can safely assume that my scale was made after 1839 but predates the name-change. As Jacob Blattner was 27 years old when he arrived in St. Louis, he would have been a fully trained, experienced instrument maker, which explains why the balance looks so Swiss.

This information, gained after the passage of so many years underlines another one of the joys of scale-collecting and one of the joys of ISASC membership. I have met many, many interesting people and have gained both knowledge and pleasure from the associations. It is always fun to have telephone-calls from other members at home and from abroad, asking to see my collection or seeking or giving information about our mutual hobby.

A person, I believe, does not "pick a hobby." A hobby picks a person. It often occurs to me, when looking over my collection, that enamelled boxes would be easier to display, oil-paintings more valuable, antique furniture more useful......but my next thought is always "Scales are more fun."

Local Verification Marks:

By N BIGGS

The Administrative Background PART FOUR -- the end of the Victorian Era

The early years of the uniform numbering system

It will be recalled that the Act of 1878 allowed the Board of Trade to set up a system of numbers to replace the various devices which had previously been used as verification marks. However, the system was not compulsory. There was an initial wave of enthusiasm, and by August 1879 numbers up to 361 had been issued. Thereafter the rate of issue fell away, with many local authorities continuing to use their old marks until about 1890.

In Table 6 there is a list giving the highest number issued in the period ending in August of the relevant year, when the annual Board of Trade Report was prepared.

TABLE 6 Issue of uniform numbers 1879–1901

Up to August	the highest number issued was	Up to August	the highest number issued was
1879	361	1887	478
1880	381	1888–9	?
1881	392	1890	538
1882	461	1891	580
1883	?	1892	592
1884	468	1893–1900	?
1885–6	?	1901	595

It appears that the usual practice was for a county to be issued with a sequence of consecutive numbers, one for each of the districts already in existence. For example, Middlesex received the four numbers 28-31 inclusive, to correspond with the four districts formerly numbered 1-4. Similarly, Berkshire received the seven numbers 449-455 inclusive, to correspond with the seven districts formerly designated by the letters A-F. In general, boroughs received only one number.

The rate of progress may be judged from the Board of Trade Report for 1882,[1] which not only included a list of the numbers issued at that time, but also listed the marks of those authorities which not yet adopted the new system. Some of these marks are shown in Figures 1-6. The non-compliers ranged from large counties, such as Cornwall and Northumberland, to dubious authorities such as the `borough' of New Buckenham (see Part 3, Fig. 27).

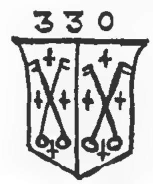
1:Cornwall 2:Nottinghamshire 3:Worcestershire 4:Arundel 5:Grimsby 6:Oswestry

There were some anomalous cases among the authorities to which numbers had been issued. The metropolitan parishes of St Marylebone (21) and St Pancras (239) received numbers because their authority was not circumscribed by the Act, and the same applied to two small Manors in east Cornwall, Calstock (193) and Callington (263). These Manors never aspired to municipal status, but they must have acquired standards at some time; indeed, the Calstock standards are listed in the Board of Trade Report for 1887 [2] as having been re-verified in that year. No example of the numbers 193 or 263 has been seen, although it appears that Calstock and Callington retained their jurisdiction well into the twentieth century (see Part 5).

Another interesting feature was that seven of the `unreformed boroughs' were issued with numbers in the period before their fate was decided by the Municipal Corporations Act of 1883. Their motivation was probably to establish that they were performing municipal functions, in the hope of being re-chartered. In four cases this worked: Aldeburgh (206), Lostwithiel (365), Lydd (431) and New Romney (462) were established as municipal boroughs in 1883, but Orford (237), Pevensey (282) and Romney Marsh (432) lost their charters for ever.

Many of the early `uniform' marks were quite ornate. The City of London combined its allocated number (2) with its former mark, the quartered shield with a dagger (Fig. 7), and the Soke of Peterborough also used its number (330) in combination with a heraldic device (Fig. 8). Manchester put thc number (5) in a circle, together with a date in its traditional style (Fig. 9, cf. Part 3, Fig. 9). Several other places used the number in a distinctive frame: these included Middlesex (Fig. 10), Surrey (Fig. 11) and Birmingham (Fig. 12).

7:London



8:Peterborough

9:Manchester

10:Middlesex

11:Surrey

12:Birmingham

The Local Government Act of 1888

One of the most important pieces of legislation in the entire nineteenth century was the Local Government Act of 1888 (51 & 52 Vict. c.41). It brought to an end the long-established rule of the county justices, and set up elected County Councils in their place. In particular, Section 3(xiii) of the Act specified that the County Councils were to be Weights and Measures Authorities.

The Act of 1888 tackled the long-standing problem of local government in London by setting up a new London County Council (LCC). This was to be responsible for the area already covered by the Metropolitan Board of Works, which included large parts of Middlesex, Surrey and Kent. It was to be the Weights and Measures Authority for its area, and was entitled to take over that function from the remaining anomalous jurisdictions of Westminster, St Marylebone, and St Pancras, as well as the relevant districts of the three old counties. Standards were purchased from these places [3] and several of the existing inspectors were transferred to the LCC.

The LCC planned to appoint fourteen inspectors in all, and fourteen numbers were allocated: 28 and 30 (transferred from Middlesex), 66, 67 and 386 (Surrey), 346, 349 and 360 (Kent), 21 (St Marylebone), 239 (St Pancras), 522, 523 and 524 (new), and finally the number 4, which had not previously been used, although it may have been reserved for Westminster. There were no further additions to these 14 numbers for over forty years but, confusingly, they were re-assigned within the LCC on many occasions. This means that several LCC district offices used the number 67 (for example) at different times, and certainly it cannot be linked with its former home, the metropolitan part of Surrey. In 1922, number 67 was being used at the Clerkenwell office (formerly in Middlesex), while 28 and 30, the former Middlesex numbers, were being used at the Clapham and Newington offices in Surrey.

The LCC used a uniform stamp which incorporated its initials, sometimes within an oval frame (Fig. 13-16). This makes it possible to distinguish a number 67 mark authorised by the LCC (Fig. 14) from an earlier one authorised by Surrey (Fig. 11).

13:No.4

14:No.67

15:No.360

16:No.522

Editor:- Have you checked the marks on your weights? Have you sent sketches of 'new' ones to Norman Biggs? Can you help to make this research complete?

Four other county-units finally achieved formal status at this time. Separate County Councils for West Suffolk and the Isle of Ely were approved by the House of Commons, while a County Council for the Soke of Peterborough was approved by the House of Lords. Also, in 1890 the Isle of Wight was granted its own County Council by the Local Government Board under the provisions of the Act. These four units, together with the LCC, were the only additions to the list of counties given in Table 1 (Part 2), and the list remained unaltered thereafter until 1965.

Another important innovation was that about 60 of the larger municipal boroughs were designated as County Boroughs. These were intended to resemble counties in the range of municipal services which they provided, and in particular they were required to be Weights and Measures Authorities.

At the other end of the scale, the Act addressed the question of those boroughs which were too small to provide the full range of services. It determined that municipal boroughs which had a population of less than 10,000 (according to the census of 1881) should relinquish certain functions, including authority over weights and measures. This affected at least 30 boroughs which had been issued with numbers since 1879, as well as several boroughs which had continued to use their old marks (Table 7). Most of the numbers involved were withdrawn, which explains why they are very rarely seen. However, a few of the numbers, such as 221 (Bewdley), continued to be used by the county which took over authority from the disqualified borough.

TABLE 7 Municipal Boroughs disqualified as WMAs in 1889

(a): boroughs which had received numbers

Aldeburgh 206	Dunstable 212	Marlborough 425	Sudbury 192
Andover 205	Harwich 461	New Romney 462	Tenterden 241
Bewdley 221	Hertford 419	Pontefract 429	Thetford 242
Bideford 261	Huntingdon 222	Ripon 463	Torrington 376
Bodmin 194	Lichfield 446	Rye 430	Totnes 243
Buckingham 196	Liskeard 234	Saffron Walden 75	Wisbech 128
Devizes 210	Lostwithiel 365	Sandwich 77	Yeovil 247
Deal 284	Lydd 431	South Molton 81	
Droitwich 211	Lyme Regis 233	Stratford-on-Avon 84	

(b): boroughs which had continued to use the old marks

Abingdon	Daventry	Launceston	Queenborough
Arundel	Guildford	Leominster	Richmond (Yorks)
Basingstoke	Higham Ferrers	Maldon	Tewkesbury
Chichester	Hythe	Oswestry	

The Weights and Measures Act of 1889

A recurrent theme in the story of weights and measures regulation has been the link with improvements in the structure of local government. Thus it is no surprise to find that the Local Government Act of 1888 was quickly followed by a Weights and Measures Act of 1889 (52 & 53 Vict.c.21). The latter was formally an Act to amend the `main' Weights and Measures Act of 1878, but in practice it was much more than that. It provided the mechanism for implementing

the recommendations of the Royal Commission of 1867-70, many of which had been avoided by the Act of 1878.

The 1889 Act represented a distinct move towards uniformity and central regulation. Perhaps its most important provision was that inspectors appointed by the local authorities would have to qualify by passing an examination set by the Board of Trade. The Act also required that local authorities should draw up regulations for the guidance of inspectors. In fact, the Board itself published a set of Model Regulations,[4] which local authorities could adopt if they wished, and most local authorities did so. Section 3 of the Model Regulations was concerned with verification marks. Among other things, it stated that:

The inspector should stamp or mark all weights, measures, and weighing instruments used in trade, with the uniform design of stamp and number of his district, as issued by the Board of Trade. Where a weight or measure is found to be in use after 1 January 1891, not stamped or marked with the uniform design of stamp referred to, the inspector should give notice to the owner or user thereof to get such weight or measure properly stamped within three months from the date of such notice. The inspector may also stamp a weight or weight or measure with the stamp of his local authority, in addition to the uniform stamp above described.

Evidently this was the end of the road for those authorities which had continued to use non-uniform verification marks. But there was one authority which did not give in. There had probably been some form of W & M regulation in Exeter long before the Act of 1835 made it mandatory, and since that time the city had used a mark showing a castle with EXON below (Part 2, Fig. 11). The city was unwilling to give up its traditional privileges, although precisely what those privileges were is a matter for further research. In any event, Exetcr continued for many years to use the EXON mark without a number (Fig. 17), even though a number (87) had been issued to it in 1879. Possibly the city argued that the Model Regulations did not have the force of law behind them, which was indeed the point of view put forward by James Roberts in the Appendix to his book[5] on the Acts of 1878 and 1889.

The regulation allowed the use of some local mark in conjunction with the uniform design, and this would have covered the use of the letters LCC as in Figure 13-16, for example. A few other counties took advantage of the provision, usually to indicate a specific division. Surrey, which had lost its metropolitan areas, now had four districts with numbers 385, 387, 388, 389, and used marks which also indicated the district letter (A, C, D, B respectively), as in Figure 18. Cornwall had only one number (9), and distinguished between its East and West divisions by the letters W and E (Fig. 19). Shropshire distinguished between its North and South divisions in a similar way (Figure 20).

17:Exeter

18:Surrey, D

19:Cornwall, West

20:Salop, South

Dates in verification marks

Section 5 of the Model Regulations provided that weights could be stamped with an indication of the date of verification, if the inspector so wished. Several localities had been accustomed to do

this in the time of the non-uniform marks, notably Manchester and its neighbours Salford and Ashton-under-Lyne (Part 3, Fig 9, 23, 25). It was also the practice in Newcastle and Sunderland.

A number of authorities now took up this suggestion, and incorporated the year, or the last two digits of it, into their `uniform' mark. The Northern Division of Staffordshire placed the two digits in the arches of the imperial crown (Fig. 21), and there were several other designs (Fig. 22-27), some of which could have led to confusion between the number indicating the year and that indicating the locality. A few authorities used a separate date mark, which was stamped alongside the verification mark (Fig. 28-30). No examples of Victorian marks indicating the month as well as the year have been seen, although this practice was later to become almost universal.

21:N.Staffs

22:E.Sussex

23:Lindsey

24:Devon

25:Macclesfield

26:Manchester

27:Norwich

28:Bradford

29:Northumberland

30:Nottinghamshire

Reorganisation in the 1890s

The first examinations for those wishing to qualify as W\&M inspectors took place in 1890. The subjects of the examination were theoretical as well as practical, and many candidates failed. One county authority (Somerset) complained that the examination was too hard -- two of their three inspectors had failed.[6] However, more candidates passed at the second attempt, and gradually the qualified inspectorate began to take over.

The insistence on qualification had the effect that several counties reorganised their W & M operations completely, and in many cases a small number of qualified inspectors replaced a larger number of police superintendents. This entailed a substantial reduction in the number of districts, and a corresponding reduction in the number of verification numbers in use. For example, Dorset had been issued with the nine numbers 158-166 for its nine police districts in 1879, but around 1891 the number of districts was reduced to two and all numbers except 161 and 163 were withdrawn. In some cases the numbers withdrawn were later re-allocated elsewhere, an apparently pointless ‘economy’. Of the seven numbers 8-14 issued to Bedfordshire in 1879, only number 8 was used after 1891; number 9 was re-allocated to Cornwall, and number 14 to Bradford.

Another effect of the requirement for qualified inspectors was that many smaller municipal boroughs decided to hand over their W & M functions to their county. In fact there were several ways in which this could be done. The borough could simply cease to be a W & M authority, in which case the county automatically assumed the responsibility, and the borough's verification number was withdrawn. This is apparently what happened in Lichfield (446), Maidenhead (466), and Ramsgate (78).

Another possibility was for the borough to retain its authority but formally combine with the county for its implementation, as allowed by Section 52 of the Act of 1878. In this situation the borough retained its number. A few boroughs, including Poole and Warwick, are recorded as having entered into a formal arrangement of this kind before 1893. Finally, there might be a more informal arrangement, such as when the borough and the county appointed the same person to act as inspector.

W & M authorities at the end of the 19th century

It is recorded that on 1 January 1893 there were 73 English municipal boroughs, not being county boroughs, which were Weights and Measures authorities.[7] The list confirms that, in accordance with the Act of 1888, there were no longer any such boroughs having a population of less than 10,000. The English W & M authorities on 1 January 1893 may therefore be classified as:

(a) the 73 *municipal boroughs* mentioned in the list cited above;

(b) the 61 *county boroughs*, comprising 59 set up in 1888 plus Grimsby and Oxford which had subsequently been granted county borough status;

(c) the 49 *county councils*, comprising the 44 listed in Part 2, Table 1, together with the five new ones created after the Act of 1888;

(d) the *city of London*

The 1893 list specifically excluded manorial jurisdictions, the largest of which was the Manor of Wakefield. Its assimilation into the modern system was facilitated by the Weights and Measures (Purchase) Act of 1892 (55 & 56 Vict.c.18). This allowed the West Riding of Yorkshire to purchase the franchise, and subsequently to transfer it, in part, to the appropriate municipal boroughs. It was for this reason that in 1892 numbers were issued to the boroughs of Wakefield (590), Halifax (591) and Dewsbury (592).

There remained one other anomaly. The municipal borough of Dover had, as early as the fifteenth century, acquired authority over a number of `liberties', in consequence of its status as one of the Cinque Ports. The liberties were outside the boundaries of the borough, and included the Thanet Liberties, covering most of what we now call Margate, Broadstairs and Birchington, together with the Liberty of Ringwould, which lies between Dover and Deal. In 1835 Dover had appointed two inspectors, one for the borough and Liberty of Ringwould, and the other for the Thanet Liberties. The Dover verification mark was a castle surmounted by the word DOVOR, and when used in the Thanet Liberties a letter L was added (Fig. 31,32).

31:Dover

32:Dover Liberties

Margate became a municipal borough itself in 1859, and event–ually separated entirely, leaving Dover still with several liberties under its control. This situation survived the reorganisations of the 1880s and 1890s, the county council of Kent being appar–ently unconcerned that areas under its general jurisdiction should be subject to Dover for Weights and Measures. Much later, in the 1950s, the matter did become contentious, but Dover was able to enlist the aid of the Lord Warden of the Cinque Ports, Sir Winston Churchill, and the claims of Kent were repulsed. The convoluted wording of Section 34 (5) of the Weights and Measures Act of 1963 seems specifically intended to preserve Dover's ancient rights. (Full details of this affair are to be found in Ronald Stocks's excellent booklet[8]). Sadly, Dover and its Liberties, like all other municipal and county boroughs, disappeared from the list of W & M authorities in the infamous local government reorganisation of 1974. TO BE CONCLUDED

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3. Saunders W, *History of the First London County Council*, 1892.
4. *Weights and Measures Inspectors and Inspection Model Regulations 1890*, HMSO, London 1890.
5. Roberts J, *Handbook of Weights and Measures*, Knight and Co., London, 1891.
6. *The Somerset Trading Standards Department: A Brief Illustrated History to Commemorate the Centenary of the County Councils, 1889-1989.*
7. Return, showing the Municipal Boroughs of which the council were, on the first day of January 1893, the Local Authority for the purposes of the Weights and Measures Acts, *Parliamentary Papers* 1893.
8. Stocks R, *Control of Pounds and Pints*, Buckland Press, Dover, 1975.

Review

The Measurers The Museum of the History of Science in Broad Street, Oxford put on a special exhibition to mark the inauguration of Jim Bennett as Keeper. A fine poster (50p), a postcard (20p) and a catalogue (£4.50) are available from the museum, (p & p for UK 50 p).

The inspiration for the exhibition was the painting *'The Measurers'* by a Flemish artist of the late 16th century, and a very similar drawing *'Les Mesures'* from the school of Frans Floris. The pictures show 26 measuring instruments and some musical instruments, being used by a builder, a music teacher, a weigh-master, a gauger, a publican, two surveyors, a miller and a cloth-seller. The instruments are so accurately depicted that they can be compared with the real instruments in the exhibition, many of which were made rather more recently than the 16th century and predominantly made in England.

The museum staff have emphasised the more sophisticated instruments used by learned men in the Low Countries in the 16th and 17th century, showing many glittering, elaborate astronomical, mathematical, navigational and surveying instruments that were **not** shown in the pictures. I found it sad that three of the four associated lectures dealt with these latter instruments and with the books explaining their use. The lectures, interesting though they were, high-lighted the academic bias towards instruments and ignored the mundane, practical uses of the vast majority of instruments in everyday use. The catalogue has an initial section on Mathematicians and their books, with a brief but thorough essay by Jim Bennett, and a final section on the Collectors and their recondite instruments, but has little to say about the subjects of the painting, regrcttably.

Allan Simpson's lecture was the delightful exception, being firmly rooted in the practicalities of weighing and measuring, and giving logical explanations for the evolution of national Standards from the earlier Mediaeval international trading standards. See EQM, p. 1987-1999. We as a Society should be encouraging the investigation of workaday instruments, their use, dissemination and development. Perhaps we should help other museums to put on similar exhibitions, backed up by the knowledge we hold between us, so that they do not resort to the back-handed compliment of discussing what is **not** inherent in the source material!

The exhibition finishes on 27 Jan 1996, but the full-colour poster (particularly attractive) and postcard of the 'The Measurers' and the catalogue are still available from the museum. D F C-H

More Flexure Springs Part 4 By D Crawforth-Hitchins

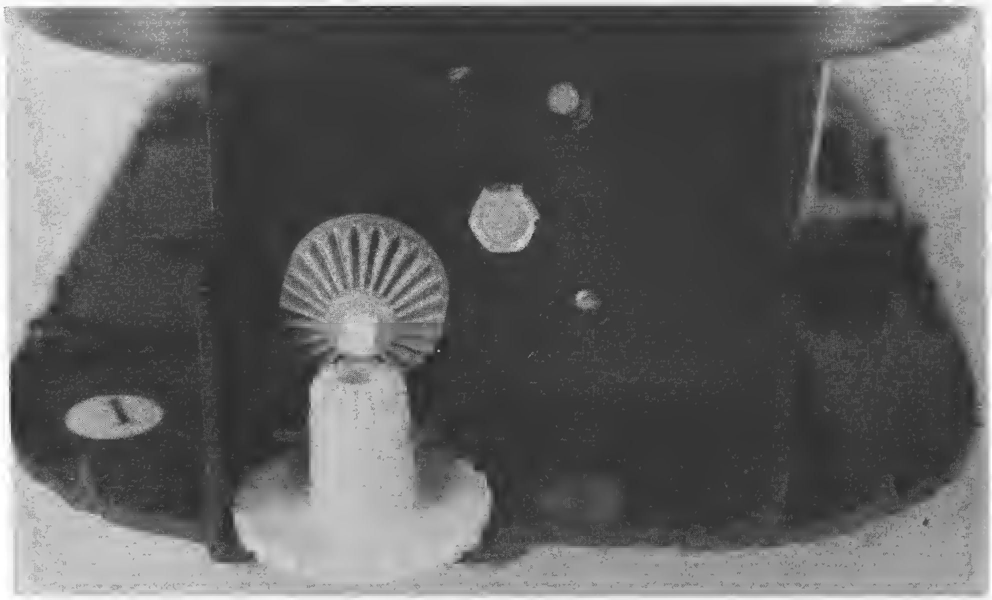
G Salter & Co. Ltd. had British patent no. 758544, of 21st March 1955, for a flat bathroom scales, with plate springs. It was still offered in the 1962 catalogue, as the *"Mayfair Personal Machine, personal weigher no. 206, Pat. No. 758544. A strongly constructed machine of most modern design. Black ribbed rubber platform prevents slipping and damage to skirting boards, and makes cleaning easy. Revolving dial has a circular magnifying lens which makes the graduations very easy to read, and at the same time excludes dust. With zero adjusting screw. The motif in the platform centre, the dial surround, and the base are available in various colours;- white, powder blue, April pink, or spring green. The machine is specially designed for portability, and is only 12¾" x 9¼" x 2¾". With shock absorbing mechanism. Each machine is packed in a strong carton. Graduated 20 St. x 1 lb., net weight 12 lb. 280 lb. x 1 lb., net weight 12 lb. 130 kg x ½ kg, net weight 5.4 kg."*

Fig. 33. Salter personal weigher, 1955.

Terraillon made a flat spring kitchen scale in 1975. Michael Crawforth's catalogue entry reads *"Two double flat springs mounted in parallel and fixed at each end to vertical steel plates. The clever arrangement of the springs forms a stable mechanism for supporting the black overhead load plate. One of the plates is attached to the base, the other to the plate carrying the load. A hinged arm attached to the fixed vertical plate carries a small helical spring which is attached to the bottom of the moving plate. The arm can be raised or lowered by means of a large plastic wheel via plastic bevel gears. A second adjustment for factory use is fitted to the end of*

Fig. 34. Terraillon. Cap reversed for use.

Fig. 35. The arm-raising adjustment/taring screw, made of yellow plastic.



the arm, being a plastic screw to retain the spring. The wheel is used to adjust the zero, and to tare other containers.

A plastic bracket attached to the fixed plate, carries a graduated circular dial which is driven by a plastic rack and pinion. The rack is driven by a bracket attached to the moving plate. This bracket is fitted onto two pegs via curved slots, and is retained by a V-spring. The purpose of this appears to be to absorb shocks etc. in the rack and pinion system for protection of the teeth. The dial is graduated 0 to 5 lbs. x ½ lb. and 0 to 2100 GRAM x 10 gm. The dial is made of white plastic and rotates behind a small red plastic index pointer.

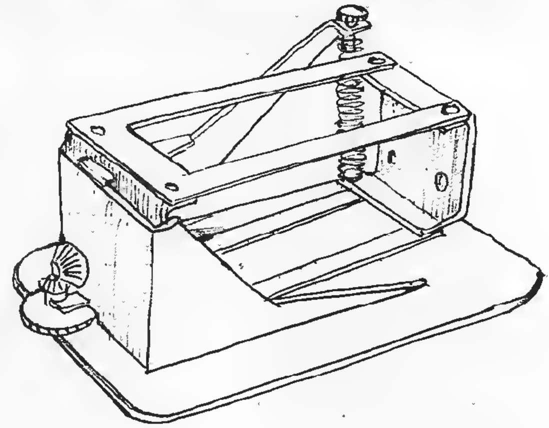
The base of the scale is a plastic injection moulding with integral support brackets etc. for the mechanism. Glued to it is a yellow plastic surround which incorporates a clear plastic lens set at about 30 degrees, to enable an enlarged view of the graduations to be seen near the pointer. A moulded plastic load plate with a deep skirt is screwed to the moving plate. The skirt conceals the mechanism and slips inside the surround when depressed. A moulded container of yellow plastic rests on top of the load plate and can be reversed for flat objects or used with its skirt upwards for a container. The base, the surround and the container are all rectangular with corners rounded on a large radius.

Fig. 36. Back-view looking into the base of the Terraillon, showing the helical spring that keeps the load-plate of the scales connected to the flexure spring. The curly flexure spring (to the right of the helical spring) keeps the arm (that connects the parallel link to the dial's rachet) in firm contact with its end fixings.

The load plate is black and is marked in white on one side "Terraillon export 2000." On top, there is an inset grey plastic panel which states "Not legal for trade," in four languages (Dutch, English, Spanish and Swedish). Inside, the load plate has integrally-moulded webs and stiffeners, and a metal mounting plate. A printed instruction sheet is provided, written in six

languages, French, English, German, Italian, Spanish and Dutch. It also notes that a 9 lb/4 kg. version is available and also a bracket for wall-mounting. The leaflet is printed in black and white and colour. The scale is supplied in a cardboard carton printed in colour, with illustrations of a scale showing that it is also available in red and black or white and black. Inside, there are two flimsy vacuum-formed grey plastic shells which hold the scale and protect it in transit. The carton is marked "1975 TERRAILLON 74103 ANNEMASSE FRANCE." Bought in Sunderland, in Jopling's sale, for £2.50, in Nov. 1976." You see why Michael got behind with his catalogue entries!

Fig. 37. The Terraillon's spring system with the dial mechanism omitted by Michael.



Other makers for your records:–

1	Leuser W H		DLO

2	E L B		C

1..Calibrated in puds for RS (Russia.)
2..Calibrated in AH=25. If any member can identify these units please write to the editor.

With thanks to Lou uit den Boogaard, William Doniger, Henri Gaçon, Bob Stein, Ruth Willard and Max Danell.

Corrections and help from Gary Batz:–

Page 1935, Fig 1, shows a coin-weight by Phillips, stated by Withers to have 'the engraver's name below the bust...tiny and weak ...difficult to read', classified as Withers 1885 A.

Line 8 of page 1969 should read .....the inscription 57.63723..

Page 1970 should refer to the least current weight of the sovereign as 122.5 grains.

Gary Batz used Rogers Ruding's *Annals of the Coinage of Great Britain and its Dependencies,* vol I, page 89.

Postal Scale

Do you collect modern scales? They are part of our history, but they are so ephemeral, they soon disappear from the market. They show the developments from earlier designs.

Utz Schmidt coll.

Weighing in the Early 14th Century

Weighing Practices in Scotland, England, and the Cities of Northern Europe in the Early Fourteenth Century– Part I

By A D C SIMPSON and R D CONNOR

There is an extended literature on early English weights and measures, but Scottish medieval metrology has so far attracted scant attention.[1] This is surprising because, when the Scottish system was formalised in the 12th century, it was based directly on English practice. It follows that Scottish sources have the potential to provide a valuable corrective for our understanding of English metrology at times when the English record is defective or ambiguous. To resolve some of the more demanding problems in Scottish weights and measures (particularly relating to the evolution of early dry capacity measures) we have had to take into account customary practices of the medieval marketplace which are not explicit in those metrological regulations that survive. In turn, this has taught us to be very cautious in interpreting early metrological texts and legal definitions, recognising that they were perfectly clear to those who operated within these conventions but may now be open to different interpretation by modern readers whose expectations have been conditioned by current practice. The close similarity between certain key English and Scottish texts shows us that English definitions contain similar trip-wires for the unwary, and we will argue that this has led to understandable but false assumptions about the nature of early English units.

Scotland's commercial economy in the middle ages was relatively small, and so it does not come as a surprise that it should have been influenced by that of its English neighbour. However, relations with England have not always been good, and Scotland's maritime trade was principally conducted with the Low Countries (and notably with Bruges in Flanders), France and the Hanseatic ports to the north. As a result, Flemish and French units have been incorporated into the metrology of Scotland. A similar situation should be anticipated in England, with some penetration of metrological units from the dominant Continental markets outside London. Evidence for this has now been found: for example, in the early weights used for the export of wool to Flanders and in the London wholesale markets for imported goods such as spices.

By analysing an important early-fourteenth-century account of merchant trading, we now have a clearer understanding of the interlocking nature of aspects of a number of European metrologies. Because this provides new information about the units for bulk weighing, it has significant implications for the re-interpretation of early English metrological texts. We now appreciate that part of the received picture of English metrology that was accepted a decade ago when that companion volume to the Scottish study, *The Weights and Measures of England*, was being written, must now be modified to take adequate account of this new international dimension.[2]

The preliminary results of our work have already been outlined at an ISASC meeting in 1993.[3] Greater detail will be given in our forthcoming volume, which provides an appropriate European context for the development of Scottish metrology. The present paper discusses some of the issues raised by the fourteenth-century merchant handbook mentioned above. This handbook was prepared by the Italian mercantile agent Francesco Pegolotti, a member of the influential Florentine banking house of the Bardi. Pegolotti rose to become manager of the Bardi branches in Antwerp (1315-17), London (1317-21), and Famagusta in Cyprus. His *Practica della Mercatura* was complied in the period prior to 1340, and it was published in 1936 from two surviving manuscript versions.[4] (For simplicity, specific references to this published work will be

given in square brackets in the text as 'Peg' with the relevant page numbers, and the extracts here are the present authors' translations from Pegolotti's abbreviated Italian.)

Aspects of our interpretation may initially seem too radical to those who have not encountered some of these weight systems elsewhere. However, the simplifications that are introduced in the units of bulk trade, which now show a strong element of international standardisation, suggest that the analysis has some merit. Very little material evidence survives from this distant period, and it must be expected that lead weights of these obsolete types were quickly recycled; nonetheless several weights have been found that appear to confirm parts of our conclusions.

The *Tractatus* Definitions

The earliest English metrological code is known as the *Tractatus de Ponderibus et Mensuris*. This survives in a number of forms and has been attributed to 1303, although it is probably at least mid-thirteenth century because of its close similarity to a corresponding text in the 'White Book' of Peterborough Abbey, part of which is dateable to *c.*1253.[5] It also appears in the legal compendium of the late-thirteenth century known as 'Fleta'.[6] The basis of the weight definitions in the *Tractatus* can be translated as follows:

By consent of the whole Realm of England the King's Measure was made, so that an English Penny, which is called the Sterling, round and without clipping, shall weigh Thirty-two Grains of Wheat dry in the midst of the Ear; Twenty-pence make an Ounce: and Twelve Ounces make a Pound ...

... the Pound of Pence, Spices, Confections, as of Electuaries, consisteth in weight of Twenty Shillings. But the Pound of all other Things weigheth Twenty-five Shillings. Item, of Electuaries and Confections the Pound containeth Twelve Ounces, and an Ounce thereof is of the Weight of Twenty-pence.[7]

The corresponding Scottish declaration is in the *Assiza Regis David de Mensuris et Ponderibus* which states (again in modern English):

Item the pound in King David's day weighed 25 shillings, now the pound ought to weigh in silver 26 shillings and 3 sterling pennies because of the diminution of the penny at present.

Item the pound should weigh 15 ounces.

The ounce contained in King David's time 20 good and sufficient pennies and now it shall weigh 21 pennies because of the diminution of the money.

King David ordained that the sterling should weigh 32 corns of good and round wheat.[8]

The text is traditionally ascribed to the reign of David I of Scotland (1124-1153). The wording has clearly been modified (and the coinage information shows that this occurred in the fourteenth century) but in all likelihood it contains elements of whatever regulations were introduced when a formal system of Scottish metrology was established initially.

These statements give the penny expressly in terms of the weight of a nominal wheat grain. The convention has been that 3 barley corns equalled the weight of 4 wheat grains and that both weighed the same as the Mediterranean carob seed: These equivalences are to be found among the documents and documentary fragments published by Hultsch,[9] which, though undated, can be estimated to the fourth and subsequent centuries of our era and in part are mentioned in the seventh-century writings of the Spanish ecclesiastic Isidore of Seville.[10] The 3:4 ratio has been utilised with success by Philip Grierson in his examination of the Carolingian coinage, with the observation that 'the precise figure varied from region to region'.[11] As for the *Tractatus*

statement that the penny weighed 32 wheat grains, Grierson notes that this 'was indeed never valid for England but was an expression of the truth for the Carolingian penny'.[12]

It would appear that in this instance two separate clauses have been run together - a situation that is certainly not unknown - but as a result considerable confusion has been created. In modern times, the interpretation has traditionally been that the penny was 32 wheat grains, equating to 24 barley grains; and the weight of the barley corn has been taken as the conventional (English) Troy grain of 64.8 mg, giving a penny of 1.55 g. Twenty such pennies would give an ounce of 31.1 g (or 480 Troy grains). However, the evidence of the coins themselves is that the penny (or sterling) nominally weighed 1.46 g (22½ Troy grains), and so an ounce of 20 pence weighed 29.2g (or 450 grains).

Fig. 1. An 8-pound weight of the English goods pound of 15 ounces of 450 grains, defined in the *Tractatus*. This example was found in Cumbria. Science Museum, London Photo R D Connor [Lit from below.]

The domination of English metrological definitions in later centuries by the Troy ounce of 480 English Troy grains has made the substitution of this ounce in the *Tractatus* seem natural. An important bullion ounce of this size was certainly contemporary with the *Tractatus* - as we will see below, Pegolotti identified it as the ounce of the Bruges silver mark. Pegolotti did not use it in the context of English bullion, but it was presumably this ounce that later became the English Troy ounce. Recently, Norman Biggs has drawn attention to the lack of evidence for the *official* adoption of the Troy ounce of 480 grains into English metrology until the late fourteenth century, and this perhaps also marks the introduction of the (English) Troy grain.[13] (Although an important element in our argument in this paper is that the English Troy grain was introduced after the period covered here, we have decided to retain the traditional use of English Troy grains in the discussion for ease of comparison with other sources.) When Pegolotti wished to make the most accurate comparisons (inevitable, between bullion weights), he did calculate in grains, but these were Paris grains of about 53.2 mg, an indication of the dominance of Parisian standards over other bullion markets such as that of London in the thirteenth century. An example of this, which we discuss in our forthcoming volume, is the use of the Paris bullion ounce as the basis for the weights operated by the London Goldsmiths' Guild.

The weight that now seems the more plausible candidate for the *Tractatus* definitions is an ounce of 450 grains. Such an ounce is familiar in English metrology as the 'Tower' ounce, used to control coinage and bullion operations at the Mint, in the Tower of London. The 12-ounce Tower pound was the monetary pound, in that it contained the weight of 240 pennies (valued at 20 shillings). The received wisdom has been that Tower weights had this very restricted application to monetary matters and that they were not used as trade weights. Pegolotti certainly described the weighing of bullion by the Tower mark of 8 ounces in London, but he provided the important additional comment that the Tower mark was the same as the Cologne mark [Peg, 255]. Cologne was then one of the principal European bullion markets, and the Cologne mark was the weight standard for currency and commercial weighing throughout north-west Germany and the Low Countries - except for Flanders, whose weight units became the currency standard for the southern Netherlands when a uniform coinage was introduced. Tower weight would therefore represent a specific application of a very widely distributed weight standard.

The *Tractatus* definitions provide for a pound for money and fine goods of 12 ounces (20 shillings) or 5,400 grains. The version of this definition in Fleta is even more explicit about the monetary weights, recording that 20 pence make the ounce and 12 ounces make a pound 'by weight and count', and therefore literally the weight of 20 pence (20 x 22½ = 450 grains).[14] Both the *Tractatus* and the Scottish Assize of David provide for a heavier pound of 15 ounces (25 shillings) or 6,750 grains for other goods. At least one surviving weight can be identified as a multiple of this English goods pound (fig. 1).[15] There is nothing incongruous in definitions of heavy goods units being given in terms of what are essentially bullion ounces - the pounds of most weight systems are merely accepted multiples of smaller units which are amenable to accurate definition. Thus, for example, the *sottile* pound of Florence, for fine goods, was defined as 12 ounces, where the ounce was a rigorously standardised bullion unit used for controlling the weight of the first international gold currency, the florin. But in addition, the Florentine heavy goods weight, the *grosso* pound, comprised 16 of the same ounces: clearly it would be used in large multiples and there would be no expectation that measurement would extend to the constituent ounces.

There is some indication that a trade weight based on the ounce of 450 grains survived in Scotland into the fifteenth century. In 1426 a new 16-ounce 'troy' pound was defined (with an ounce of 480 grains), and it was related to an existing 'Scots' pound, which was a merchant pound used in binary divisions.[16] If the constituent divisions of the `Scots' pound were 16 ounces, then the ounce was 450 grains. (There is some doubt about whether a formal definition at this time might have been given as 15 of the new `troy' ounces of 480 grains, but it is clear that its practical divisions were multiples of 450 grains, and it can be seen as a successor of the pound of the David Assize.)

This new proposal that the weight units of the *Tractatus* and David Assize were based on the Cologne or Tower ounce and not on the Troy ounce can be tested against the data presented by Pegolotti, and it will be seen in Part II that the proposal is compatible with the size of a general trade hundredweight that can be deduced for London in the early fourteenth century.

Bullion Weights

Pegolotti's handbook contains extensive information on the coinages, currencies of account and duties payable on the various commodities in which the Bardi bank had an interest. The data he gathered has been extensively used by fiscal historians,[17] but it seems that the information on commercial weights and weighing has been largely bypassed.[18] As Pegolotti travelled from one

European trading centre to another he was able to observe procedures in the markets and to record the weight units of the cities and the relationship between them, as well as the all-important weights and finenesses of coin. His concerns were very largely with international trade, so he paid little attention to the workings of internal markets. Thus, when he discussed Paris (which he does not appear to have visited), the weights referred to are the 16-ounce merchant pounds of external trade. This weight differed from another Parisian pound, which Pegolotti specifically stated to be of 15 ounces, which appears to have been the heavy goods pounds of the Paris internal market [Peg, 148, 221, 236].

Pegolotti gave specific and accurate equivalences for bullion, and for convenience we give them here in terms of English Troy ounces, although it must again be stressed that Troy ounces and Troy grains were not in use at this time. The Bruges (or Flanders) gold mark of 8 ounces was stated to be the same as the Paris mark (of 8 ounces), and in London this weight was said to be equivalent to 8 ounces and 8 sterlings [Peg, 245]. Since there were 20 sterlings to the Tower ounce, the Bruges gold mark and the Paris mark were both equivalent to 8.4 Tower ounces, or 8.4 x 450 = 3,780 grains. Both marks were of 8 ounces, so the Paris ounce and Bruges gold ounces were 472.5 grains.

This ounce size is confirmed several times in the text, but nowhere more accurately than in the relation between the Bruges silver mark and the Paris ounce: 'The Bruges silver mark of 6 ounces is such that 21 of them equal 16 gold marks' [Peg, 237]. Since the gold mark was 3,780 grains, the Bruges silver mark was 3,780 x 16 ÷ 21 = 2,880 grains. Because this was a 6-ounce mark, the Bruges silver ounce was 480 grains. However, Pegolotti also gave a very specific definition in terms of fractions of the Paris grain: 'In Paris, the Bruges silver mark is 6 ounces 2 deniers and $6^{6}/_{7}$ Paris grains with 24 deniers to the ounce and 24 Paris grains to the denier' [Peg, 237]. Hence the silver mark of Bruges was 6.09524 Paris ounces, or 6.09524 x 472½ = 2,880.00 Troy grains. The uncertainty in the size of the silver mark implied by Pegolotti's statement is no more than one-fourteenth of a Paris grain, or about 0.06 English Troy grains, giving the silver mark is 2880.00 ± 0.06 grains. From these two equivalences it follows that the Paris ounce is accurately 472½ grains to within 0.01 grain. The Paris ounce was maintained very precisely at this level for an extended period, and it was for example confirmed as 472.50 English grains in the 1742 comparisons made by the Royal Society in London and the Académie Royale des Sciences in Paris.[19]

The Paris ounce of 472½ grains was perhaps the most significant of the bullion ounces in Pegolotti's account, and he recorded that the same standard was used for gold in Bruges. The silver ounce in Bruges was 480 grains (the mass subsequently adopted as the English Troy ounce). However, the standards for the rest of the County of Flanders differed from those of Bruges, its chief entrepôt, and Pegolotti recorded the size of the two Bruges marks in terms of the Brussels' weights as 8 ounces and 8 pence for the gold mark and 6 ounces and 8 pence for the silver [Peg, 244]. This shows that the single ounce standard in Brussels was the Cologne ounce of 450 grains, and Pegolotti made it clear that this was also the ounce of the neighbouring Duchy of Brabant and of Antwerp, its principal commercial centre. Antwerp, at the north end of the most important overland route in Europe, from Venice, was to overtake Bruges in the late fifteenth century as the main entrepôt of north-western Europe.[20] The Cologne ounce was also used as the Tower standard of England, and it came to be adopted as the currency standard of the Holy Roman Empire. These ounce sizes were not arbitrary and independent sizes. The ratio of

the Paris to the Bruges silver (or Troy) ounce was 21:20, and that of the Bruges silver ounce to the Cologne (or Tower) ounce was 16:15.

In summary, the bullion ounces we have referred to (for the late thirteenth century and the early fourteenth century) are as follows:

472½ grains:	Paris; Bruges (gold); London (used by Goldsmiths' Company)
480 grains:	Bruges (silver)
450 grains:	Antwerp; Brussels; Cologne; London (at the Mint in the Tower)

Thus, in Pegolotti's time, there were a comparatively small number of bullion ounces. This restricted group of ounces formed the bases of national weight systems. But since the ounces were precisely related in simple arithmetic ratios, it would be expected that the weight systems would exhibit similar relationships - in other words that there would be an element of international uniformity. Almost certainly this would come about from early trading pressures exerted by the dominant commercial markets.

Trading Weights

Pegolotti provided a range of equivalences linking the weight systems of the various trading centres in which his firm had interests. We will exclude from the present discussion the majority of Italian and eastern Mediterranean markets, and concentrate here on equivalences given by Pegolotti between the weights of London, Paris, Bruges and Antwerp in northern Europe, and Florence in Italy, the city state that played the major part in opening up trade with the markets in the north. These are provided in the following form:

100 pounds London = 96-97 pounds Paris	[Peg, 257]	(1)
100 pounds London = 138-140 pounds Florence	[Peg, 202]	(2)
100 pounds Bruges = 92½ pounds London = 92½ pounds Antwerp	[Peg, 244]	(3)
100 pounds Bruges = 88-89 pounds Paris	[Peg, 245]	(4)
100 pounds Florence = 78 pounds Bruges	[Peg, 246]	(5)
100 pounds London = 100 pounds Antwerp (for spices)	[Peg, 256]	(6)

In all these instances, the pounds were used in bulk transactions which were reckoned in 'hundreds' of pounds, and often in terms of units known as 'loads'. In the case of Paris, Pegolotti emphasised that the load weighed 350 pounds, and the hundred weighed 100 pounds - this 'hundredweight' was the weight of a short hundred (5 score) pounds, rather than that of a long hundred (6 score, or 120) or some other 'hundred' [Peg, 236]. Indeed, by relating these various equivalences it is clear that when Pegolotti spoke of a 'hundred', unless the term was qualified, he meant 5 score. It is important to recognise that these equivalences are for bulk weights - they may be given to the nearest pound, presumably representing an acceptable rate, or as a narrowly bracketed range (as at Paris and Florence) which may signify for example handling duties which depended on the direction of trade.

Of the cities discussed in this paper, only in the case of Bruges did Pegolotti specify how many ounces the trading pound comprised - the pound was of 14 ounces [Peg, 237]. These ounces were the 480-grain ounces of the Bruges silver mark, so the commercial pound of Bruges comprised 14 silver ounces, or 6,720 grains. This is a most surprising multiple of ounces because historical accounts of the weights of this region lead us to expect only pounds of 16 ounces. However, the figures are self-consistent, and it becomes apparent that 14-ounce pounds were progressively replaced by 16-ounce pounds as the century progressed. In some applications, such as the weighing of wool (see Part II of this article), 14-ounce pounds had already become

obsolete by Pegolotti's time: wool had certainly been weighed by the pound of 6,720 grains in the thirteenth century, but by the fourteenth century this had been replaced by a pound of 7,000 grains. Surviving weights with pounds of 14 ounces are now very rare, but they have not entirely disappeared: the Gruuthuse Museum in Bruges has a few early hemispherical weights in units of pounds of 428.6 and 428.7 g (6,614 and 6,616 grains), dateable to before 1350, which are presumably standards of 14 x 472½ = 6,615 grains.[21] We tentatively suggest that 14-pounds are characteristic of Flemish trade influence.

Fig. 2. Quarter of a pound of 14 ounces of 472½ grains, presumed to be a fine goods weight for use in Flemish trade with England, and found in Suffolk. Photograph greatly enlarged, the weight being only 49 mm high x 35 mm wide. National Museums of Scotland, Edinburgh. Photo K Smith

An apparently difficult consequence of multiples like 14 and 15 ounces to the pound is that they have inconvenient and few factors - a feature that may ultimately have led to the widespread use of 16-ounce pounds. The difficulty comes with the supposition that ounce units would form the subdivided parts of the pound for weighing small quantities. In practice this was not the case: regardless of the way in which the pound was defined in relation to the definition ounce, if the pound needed to be divided then it was divided at the retail level in a binary fashion - into half-pounds, quarter-pounds and so on.

This can be illustrated well with a weight of about the thirteenth century, recently excavated in south-east England (fig. 2).[22] Despite the fact that it is a division of a 14-ounce pound (in fact a pound of 14 x 472½ grains), it is simply a quarter of the pound - a division that surely takes no account of the arithmetically inconvenient multiple in its definition. The same must have been true of the 15-ounce pounds that were the internal goods pounds of England and Scotland (defined in the *Tractatus* and the David Assize) and that of France (discussed below). When small quantities had to be analysed, then presumably only ounces and their appropriate (bullion) divisions were utilised, and it might even be inappropriate to record outcomes in pounds.

Taking the equivalence (4) of Bruges pounds, established as 6,720 grains, and Paris pounds, the Paris pound comes to between 16.0 and 16.2 Paris ounces of 472½ grains. Thus within the expected limits of accuracy, the Paris pound appears to be one of 16 ounces, or 7,560 grains. As already noted, there is a clear distinction between this pound - a merchant trade pound for external trade (the intended scope of Pegolotti's handbook) which presumably originated as a pound of two marks - and another Paris pound mentioned by Pegolotti and described as of 15 ounces, and therefore 7,087½ grains [Peg, 148, 221, 236]. This 15-ounce goods pound is likely to have been the earlier of the two (and we will elsewhere show its application in the English *Tractatus* definitions), and we believe it remained in use as the normal unit of internal trade. Pounds of this size also seem to have been in use in Scotland in the first half of the sixteenth century, a period of strong French influence on the Scottish court. The 15-ounce Paris weight can be seen as the analogue of the early internal English goods pound of 15 x 450 = 6,750 grains, although unfortunately the latter was not mentioned by Pegolotti (except to record its hundredweight as 112 pounds). The related, but larger, pound for wool (discussed in Part II) was recorded by Pegolotti, who referred to it as the 'English' pound, since wool figured amongst his export interests [Peg, 254].

Equivalences (3) and (6), of which the second relates specifically to trade in spice, show that this London or Antwerp pound can be calculated from the Bruges pound as 7,265 grains (100 x 6,720 = 92½ x 7,265). The likely error implicit in equivalence (3) is no more than about ¼ pound, and so this pound is within the range 7,265 ± 20 grains. The mass is not compatible with a multiple of ounces of 450 grains, so the inference is that this pound is in some way peculiar to trade in spices through Antwerp, and that the Antwerp pound is also used for wholesale distribution in the London spice market. This market was in the control of the officials of one of the London guild companies, the Pepperers' or Spicers' Company (later the Grocers' Company), and like guild companies with similar responsibilities (such as the Goldsmiths') they retained their own standards, in this case of the Spicers' pound and its multiples. Pegolotti noted that the hundred for spices in London was 104 pounds (but 100 pounds in Paris) [Peg, 254]; and we will return to this in Part II. Since Pegolotti also provided details of the weight of the load of spices in London and Antwerp (both 364 pounds) and Paris (350 pounds) [Peg, 256-257], we can use these larger quantities to provide a better estimate of the London spice pound, namely 7,560 x 350 ÷ 364 = 7,269.23 grains.

The size of Pegolotti's 'London' spice pound might seem implausible, but a fine example of a 1 pound weight of this series has survived (fig. 3).[23] The current mass of this weight is only 6 grains less that the size deduced from Pegolotti's data.

From equivalence (5) - that 100 pounds at Florence is 78 pounds at Bruges - the Florentine pound can be calculated as 6,720 x 78 ÷ 100 = 5,241.6 grains. The weight of the gold florin of Florence, first issued in 1252 at 96 to the pound, has been accepted for a number of years as 3.536 g or 54.56 grains.[24] The Florentine pound of 5,241.6 grains deduced from Pegolotti's figures implies a florin weight of 54.6 grains, which is in excellent agreement. This pound is the 12-ounce *sottile* pound of Florence, for fine goods, and the ounce is therefore 436.8 grains. The heavier *grosso* pound for other goods contained 16 of these ounces, as previously mentioned, making 6,989 grains.

If we are now to refine Pegolotti's equivalences (1) to (6) in order to give more exact relationships between these various pounds rather than the working approximations which presumably carried marketplace acceptance, then these would be as follows:

100 London or Antwerp pounds = 96.2 Paris pounds = 138.7 Florence pounds (1), (2), (6)
100 Bruges pounds = 92.4 London or Antwerp pounds = 88.9 Paris pounds (3), (4)
100 Florence pounds = 78.0 Bruges pounds (5)

The point to emphasise here is that, in addition to the English goods weight of 15 Cologne (or Tower) ounces, there was at least one other trade weight in operation in London which had no known statutory basis - and it was sufficiently prominent for Pegolotti to have styled it the 'London pound'. We must add to this the English wool pound and the 7,000-grain 'avoirdupois' pound, both of which are discussed in Part II, which were also in use in England from before Pegolotti's time. But the early English regulations about weights do not distinguish between pound types, except to record that there were pounds of 12 and 15 ounces, and so it is apparent that they need to be interpreted with some care.

Fig. 3. Pound weight identified as Pegolotti's 'London pound' for wholesale weighing of spices in London. This example is understood to have been found in London. Private collection Photo P Withers

Methods of Weighing

A further technical complication arises from the method of weighing bulk goods in north European markets in Pegolotti's day. From early antiquity, all articles of high value - such as gold, silver, coins, pearls and precious stones - were weighed with the beam of the balance horizontal, and it must have been known in very early times that the beam would become horizontal when equal masses (or weights) were placed in the two scale pans. As in modern times, thc truc wcight of a commodity is that given with the beam horizontal, and we tend to think that this is the only acceptable way of conducting a fair and accurate transaction.

However, even in recent times, balances have not always been used with the beam horizontal. The authors can recall that the standard practice in British sweet (candy) shops was for the shopkeeper to pour from his glass bottle into the goods pan of his scale, until the beam went a little beyond the horizontal - in the words of a much earlier account (see below), the beam 'inclining towards the goods'. However, we only paid for the weight defined in the weight pan, and this was the standard custom for the retail of all manner of groceries, cooked meats, nuts, etc. Today, although the concept of minimum weights for pre-packaged foods is still maintained, this practice of giving the customer a little extra and letting him feel he has come out of the transaction well, has disappeared with the advent of electronic scales. On these, if the reading comes to 405 g in response to our request for 400 g, and if we agree to accept this weight, we receive and pay for the full 405 g. In early medieval times the use of inclined beams was widespread for bulk transactions, and although the purchaser was able to ensure that he got at least the weight required, the vendor was not the loser because there was a compensating adjustment in the weight system.

Weighing with the beam inclined is of considerable antiquity. The earliest we have found is the procedure outlined in the Babylonian *Talmud*, the comprehensive gathering of Hebrew law and regulations compiled before about A.D. 500. This stipulates that the scales were to be suspended to give adequate clearance from the floor so that the beam could incline, and specifically that:
the shopkeeper must allow the provision scale [pan] *to sink to a handbreadth lower than the scale* [pan] *of the weights but if he gives exact weight* [i.e. with the beam horizontal] *he must allow him...one twentieth* [5%] *in the case of dry measure ...*[25]

With a true mass of 1 pound in the goods pan, and with an inclined beam, there might be 0.95 pound in the weight pan - and the buyer would pay for that 'weight'. With the beam horizontal and again with 1 pound in the goods pan, the scale would read 1 pound (i.e. true weight), and so more money would be demanded. To make the two weighings just, with the beam horizontal, the seller was constrained to give the buyer 5% more - equivalent to charging for 95% of the quantity. In this way the unit cost would be the same regardless of the mode of weighing.

The practice of inclined-beam weighing continued into the later middle ages, and with the figures provided by Pegolotti it can be deduced that this method of weighing was used, at least at the wholesale level and for the shipping of goods, at the principal north European markets. Similar conventions applied at these centres, perhaps with an acceptance that the goods pan should just clear the floor or the counter, as appropriate. There is a remarkably clear description of the distinction between inclined-beam and level-beam weighing in London in 1257, when (initially unsuccessful) attempts were made by royal officials to enforce level-beam weighing at the King's great beam. The Latin of the *Liber de Antiquis Legibus* may be translated as:
The King's Beam in the City of London -
The usual provision is when goods are weighed on a balance that the beam incline towards the goods except gold and silver which are always weighed on a level beam, neither drawing towards the weights nor towards the gold and silver ... but from the Sabbath following the Feast of St. Nicholas [6 December] *in the xli year of the reign of King Henry* [III], *son of King John, all goods which must be weighed by the King's beams in the City are to be weighed as gold and silver without drawing towards the goods, in lieu of which the seller must give the buyer four pounds in every hundred.*[26]

Here we see that in the mid-thirteenth century the compensation necessary for moving to level-beam weighing was 4%, only a little different from the 5% designated nine centuries earlier in the *Talmud*. In fact the 4% compensation also emerges from Pegolotti's early-fourteenth-century figures for Bruges, Antwerp and London (although there is no direct reference to such weighing techniques), and it is also implicit in new procedures for weighing wool in England introduced in the late thirteenth century. The tax on wool was one of the principal sources of English royal revenue, and wool was weighed by royal officials who were able to insist that, for this commodity at least, level-beam weighing was necessary. It was not until 1340 that a requirement to weigh by level beam was included in English statutes.[27] It undoubtedly took an extended period to phase out inclined-beam weighing in trade, and it was not until the next century that level-beam weighing became the norm.

For an inclined beam to operate successfully, it must have the correct geometry, with the knife-edges out of line. The implication from the use of the same weighing conventions in different trading centres is that the great beams were constructed with the same characteristics. However, this would not represent a difficulty because the standard weights that were related by these two different weighing procedures were well understood and readily available. It is also likely that

many of these large balances would have come from the same manufacturing areas, in the same way that centres such as Nuremberg developed particular expertise in constructing and adjusting nesting weights.[28]

The notable exception to the use of inclined-beams weighing in Pegolotti's handbook is the procedure at Florence, where he was careful to state that there was a balance for general weighing and a steelyard for wool weighing [Peg, 190]. The steelyard (or *stadera*) was used with the beam horizontal - an important difference to which we will return in the second part of this article.

TO BE CONCLUDED

Acknowledgements

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Notes and References

1 The present authors are preparing an extended study of Scottish metrology, presented not as an isolated topic, but in relation to the metrologies of Scotland's trading partners. This will be published in 1996 as *The Weights and Measures of Scotland*. Lawrence Burrell's article, 'The Standards of Scotland', *Monthly Review of the Institute of Weights and Measures Administration*, 69 (1961), 49-60, is a frequently cited but unsatisfactory source. Two recent volumes treat Scottish metrology in the course of detailed economic analyses: Elizabeth Gemmill and Nicholas Mayhew, *Changing Values in Medieval Scotland* (Cambridge, 1995), and A J S Gibson and T C Smout, *Prices, Food and Wages in Scotland, 1550-1780* (Cambridge, 1995).

2 R D Connor, *The Weights and Measures of England* (London, 1987).

3 A D C Simpson, 'European Medieval Trading Weights: Implications for English Metrology', presented at the Annual General Meeting of the ISASC European Chapter, Long Eaton, 24 October 1993.

4 Francesco Balducci Pegolotti (ed. Allan Evans), *La Pratica della Mercatura* (Cambridge, Mass., 1936).

5 *Statutes of the Realm*, 11 vols (London, 1810-1828), I, 204-5, the translation reprinted in Connor, *op. cit.* (2), 320. The *Tractatus* is not strictly a Statute but has been described as a private memorandum of extremely valuable information: Philip Grierson, *English Linear Measures: an Essay in Origins* (Reading, 1972), 13. For the White Book of Peterborough Abbey, see Hubert Hall and Frieda J. Nicholas, *Select Tracts and Table Books relating to English Weights and Measures (1100-1742)*, Camden Society Miscellany, 15 (London, 1929), 11-12.

6 H G Richardson and G O Sayles (eds. & trs.), *Fleta, II*, Selden Society, 72 (London, 1955), Ch 12, 119.

7 Connor, *op. cit.* (2), 320.

8 T Thomson and C Innes (eds.), *The Acts of the Parliaments of Scotland*, 13 vols (Edinburgh, 1814-1876), I, 673-674.

9 Friedrich Otto Hultsch, *Metrologicorum Scriptorum Reliquiae* (Leipzig, 1864-1866; reprinted Stuttgart, 1971), I, 248; II, 128 & 84; see also I, 81-85.

10 Isidore, *Bishop of Seville* (ed. W M Lindsay), *Etymologiarum sive originum libri XX* (Oxford, 1911), II, xxv.

11 Philip Grierson, 'Money and Coinage under Charlemagne', in W Braunfels and H Schnitzler (eds.), *Karl der Grosse* (Dusseldorf, 1965), I, 529-530.

12 *Ibid.*

13 Norman Biggs, `English Weight-Systems in the Fourteenth Century - a New Interpretation', privately circulated paper, December 1990.

14 Richardson and Sayles, *op. cit.* (6), 119.

15 This fourteenth-century lead weight of 54,075 grains with a *fleur-de-lys* motif (Science Museum, London, Inv. 1989.120) is described by J. E. Satchell, `The Bretherdale Wool Weight', *Transactions of the Cumberland & Westmorland Antiquarian & Archaeological Society*, 89 (1989), 131-140. This is based on an early identification as a 7-pound wool clove of 16 x 480 grains (53,760 grains): Connor, *op. cit.* (2), 128. It is now suggested that the weight is 8-pounds of 15 x 450, or 54,000 grains. The difference of 75 grains is compatible with carbonate development at the surface.

16 *Acts of the Parliaments of Scotland*, *op. cit.* (8), II, 10.

17 See for example, Peter Spufford, *Money and its Use in Medieval Europe* (Cambridge, 1988).

18 But see the inconclusive study of R E Zupko, `Notes on Medieval English Weights and Measures in Francesco Balducci Pegolotti's "La Pratica della Mercatura"', in D Herlihy, R S Lopez and V Slessarev (eds.), *Economy, Society and Government in Medieval Italy: Essays in Memory of Robert L Reynolds* (Kent, Ohio, 1969), 153-159.

19 'An Account of the Proportions of the English and French Measures and Weights, from the Standards of the Same', *Philosophical Transactions*, 42 (1742-3), 185-188. This value differs from the ounce mass of 30.594 g (471.13 grains) derived from the authoritative 50-mark *Pile de Charlemagne* (constructed in Paris between 1460 and 1510): *Inventaire des Poids [du Conservatoire National des Arts et Métiers]* (Paris, 1990), 22: C.N.A.M., Paris, Inv. 3261. However, the lower figure is compatible with its use as a bullion receipt standard, and this is discussed in our forthcoming volume.

20 Peter Spufford, 'The Burgundian Netherlands', in Alain Arnould and Jean Michel Massing, *Splendours of Flanders* (Cambridge, 1993), 1-11.

21 We are indebted to Gerard Houben for drawing our attention to the survival of these weights: personal communication, 27 April 1993.

22 The present mass of this weight is 107.15g (1,653.5 grains), and a quarter of a pound of 14 x 472½ grains is 1,653¾ grains. National Museums of Scotland, Inv. T.1993.31. Excavated at Lavenham, Suffolk, and donated by the finder John Goodall; acquired through the interest of the Suffolk County Council Archaeological Service.

23 The weight, carrying three lions passant, is in a private collection. Illustrated by Norman Biggs, *English Weights: an Illustrated Survey* (Egham, Surrey, 1992), 42.

24 Philip Grierson, `The Weight of the Gold Florin in the Fifteenth Century', *Quaderni Ticinesi di Numismatica e Antichità Classiche*, 10 (1981), 421-431.

25 I Epstein (ed. & tr.), *The Babylonian Talmud, Seder Nezikin, Baba Bathra* (London, 1935), 88b-89b, 361 *et seq.* It is strange that Bruno Kisch, *Scales and Weights* (New Haven, Conn., and London, 1965), 48-51, while giving this reference for the floor clearance of the pans, made no comment on weighing by the inclined beam.

26 T Stapleton (ed.), *Liber de Antiquis Legibus*, Camden Society, 34 (London, 1846), 25. A similar declaration, also cited by Stapleton, is in Fabyan's *Chronicle* of 1516 (Septima Pars, Henrici III, fol.xxviiib): see Robert Fabyan (ed. H Ellis), *The New Chronicles of England and France* (London, 1811).

27 14 Edward III Stat.I c.21; see Connor, *op. cit.* (2), 137.

28 Even in the seventeenth century Scottish burghs were still ordering steel beams from the Low Countries: *Records of the Burgh of Stirling*, 30 August 1654 and 19 January 1676.

Review

Equilibrium Index, available from the Publications Officers of ISASC. This is the second index to the ISASC journal Equilibrium (the outdated index having covered pages 1-624), and covers pages 1 to 1200 over the years 1979 to 1989. It is a fifty page document, each page having three columns of references to descriptions and to diagrams, figures and photographs. I estimate the number of references and cross-references to be of the order of 11,000 entries.

A brief introduction to the Index explains its intentions and is worth quoting in full:-
....(the) aim has been to allow a collector to look at a distinctive feature on the scale or weight and find the information pertaining to it in EQM. The index enables a collector to look up a name, a shape, a nationality, a material, a principle of weighing or a word and have a good chance of getting help. This has involved elaborate cross-referencing and careful sub-division, making it a valuable research tool of unusual scope. All reference material, books, old advertisements, old catalogues and every article have been indexed to allow maximum use of these rare resources. The result is a bibliography of great interest to a wide range of users..

The EQM editor, Diana Crawforth-Hitchins, deserves to be congratulated on compiling such a useful tool - especially since the journal would not have been word-processed during the years covered by the index, always a help to index-compilation.

Obviously it is not possible to check every entry, but those that I have checked proved sound and immediately useful. In fact the whole index is an instrument in its own right, enabling the researcher to gain scientific information that would otherwise remain hidden.

Such an index must be of value to anyone in ISASC (and to many who are not!) For those who have the relevant copies of EQM, it is an essential addition P Holroyd

Auction

Bowers & Merena Inc, Box 1224, Wolfeboro, NH 03894, had a scales/medal/coin auction on 13 November, 1995, with a magnificent catalogue, prefaced by a concise article "Collecting Antique Scales" by George Mallis (another long-standing member of ISASC). He also wrote the comprehensive descriptions of each of the 253 scales and 9 sets of weights. Ruth Willard (vice-president of ISASC) wrote the descriptions of the 7 lots of Burmese animal weights. They and the photographer produced a superb catalogue, which went into the greatest detail, guaranteeing plenty of enthusiasm, and expanding the knowledge of the collector in a quite exceptional way.

Most of the CCDs and folding coin scales were English, as were the majority of the highly-ornamental postal scales. Who has seen so many decorative robervals in one place~ a profusion of marble, malachite, agate, tortoiseshell, gilt and buhl~ many by S Mordan and most with original weights? Some were rare or desirable~ a Pan steelyard (see EQM p. 1288)~ a Gorham silver, spring "beehive" (see EQM p. 1669)~ a Sheldon silver spring registered in 1842 (see EQM p. 1682)~ an H Bell equal-arm folder with compound weights (see EQM p. 1828)~ a Tiffany & Co roberval~ a P Orr & Sons bismar~ an equal-arm postal scale on a pillar with ounce and tola weights. I recommend your acquiring the catalogue for your library, as another excellent source of information and pleasure. D F C-H

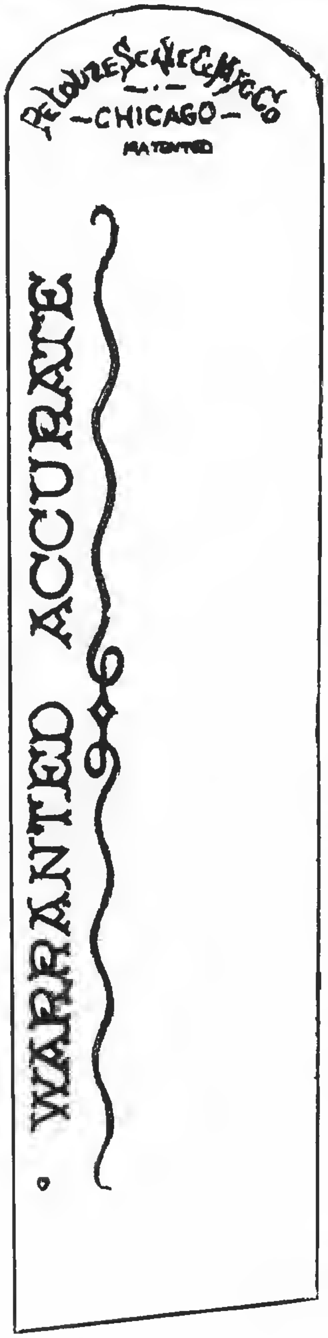
Pelouze Straight Spring Balance

from T STEIN

The Straight Spring Balance is illustrated in the Norvell-Shapleigh Hardware Co. catalogue of 1903 without any comment as to its efficiency or function, just

No. 50P- Capacity ½ x 50 lbs.....$8.00 per dozen *No. 50P, Third dozen in a box*
No. 100P-Capacity 1 x 100 lbs $24.00 per dozen *Others Quarter dozen in a box*
No. 150P-Capacity 1 x 150 lbs $30.00 per dozen *Average weight per Dozen, 18 lbs.*

The date of the patent is not stamped on the face, hinting that the patent no longer gave protection, and might have been taken out long before 1903.



The same balance is shown in the undated Pelouze catalogue reprinted by ISASC as "A Retrospective of Scale Catalogs", with the comment, *"These balances have steel frames finished in Black enamel. The dials are brass with distinct figures and graduations. the springs are made from special crucible steel and are extra strong and sensitive. Rings and hooks are finished in black enamel. No. 50 packed 6 to the carton. Nos. 100, 150, and 210 packed 4 to the carton."*

Another version of the same balance had fancy writing that would date it to about 1880, if it were English (see the drawing on the left) for "PELOUZE SCALE & MFG CO". Even this version has no date of patent. Michael Crawforth wrote *"Coil spring in tension which is entirely external to the case! A steel suspension ring is attached to the top of the case, and the spring is attached to the bottom. The lower end of the spring is looped to suspend the load-hook, and bends round again to continue right up the centre of the spring and up behind the face to the top of the case. A collar carrying a brass pointer is fixed to the extension of the spring, and is locked in place by a small screw. A brass face is located vertically by grooves in the folded sheet steel case, and is retained in the correct position by a pin. The face is graduated 0-150 x10 (lb units not marked.)"* It is 19½ inches (500 mm) high, the spring being 6½ inches of that. It weighs up to 150 lbs, divided into tenths of a pound, not into ounces!

Can any member supply patent dates? Does any earlier catalogue evidence exist? When was the company called Pelouze Scale & Mfg Co.? What other products did they manufacture?

ISASC should standardise the vocabulary for springs. Michael called them coil springs early in his research, and helical springs when he aimed for greater precision, (tension or compression). Chatillon called them spiral springs, (extension or compression.)

ISASC

EQUILIBRIUM

QUARTERLY MAGAZINE OF THE INTERNATIONAL SOCIETY OF ANTIQUE SCALE COLLECTORS

1996—ISSUE NO. 2

PAGES 2001-2028

Cover Picture

Any equal-arm coin scale by an English provincial maker is rare, as London makers produced well-made coin scales in vast numbers. The coinage in 18th and early-19th century England was cut down (diminished), sweated (chemically reduced), abraded or counterfeited, so that the users of any gold coin had to negotiate about the value of gold remaining. In the area of England where William Arstall lived, in Lancashire, folding guinea balances (see EQM, p. 200, 627 and 1942) were commonly made and used to decide the value of the coin, but even the most sensitive of the folders only dealt with coins that had lost less than 12 pence-worth of gold. If the user had a foreign gold coin or a coin that had lost a lot of gold, he needed an equal-arm scale with grain weights to determine the value of gold remaining.

William Arstall is known to have retailed five folders, probably made by A Wilkinson of Kirby, 12 miles N, and T Houghton of Farnworth, 4 miles NE of Hale-bank. He may well have been friends with these men. He probably made the two surviving equal-arm coin scales that have his label, both scales being of fine workmanship, but subtly different from the London style. Apparently he started his working life in Hale-bank, a hamlet which is 9 miles SSW of Warrington on the wind-swept marshes created by the broad estuary of the River Mersey. It is not known when he moved to the Prescot area, six miles due N, but presumably it was before 1798, when the third of a guinea was first minted. Prescot was famous for clock- and watch-makers who assembled parts made by their neighbours, in an early version of mass-production. He died in Sutton near Prescot in 1825/1826, leaving his estate to his wife, Mary. He was probably the "Mr. Arstall senior of Blackbrook" mentioned by Henry Wright on page 2007.

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George Arstall

By A MORRISON-LOW

George Arstall and scale-beam manufacture in early nineteenth-century Liverpool

Advertising wars - of the sort recently encountered in the British media between rival soap-powder manufacturers - are a very expensive way of trying to tell a less-than-impressed public that one product is perhaps marginally better than another. In the early 19th century, newsprint was heavily taxed, and it is therefore interesting to note that a similar squabble, characterised by the intemperate language of the times, was conducted for six months in newspapers in Liverpool.

George Arstall worked in Blackbrook before he made his first appearance in Gore's *Liverpool Directory* as a scale-beam and mathematical instrument maker, at 7 North side Old Dock, in 1807. By 1810, he was described as a scale-beam maker, and maker of Dicas' hydrometers, with his manufactory at 1 Temple Court, and it is this latter instrument which has proved of some interest to historians.[1] The Dicas hydrometer, used for measuring the specific gravity of alcoholic liquids, had been invented by John Dicas, a Liverpool wine and brandy merchant, and patented by him in 1780. Ten years later it was adopted by the United States government as their standard instrument for assessing import duty. John Dicas had died by 1802 when the Board of Inquiry of the Royal Society was advertising in local newspapers throughout the United Kingdom, inviting instrument makers to bring forward hydrometers which could be tested for adoption by the Customs and Excise for taxation purposes. His business was by then being run by his daughter Mary Dicas, and she took examples of her father's instruments, when she was among ten makers who explained their use before the Board of Inquiry in London. However, her bid was unsuccessful, and the Excise adopted the hydrometer devised by Bartholomew Sikes.

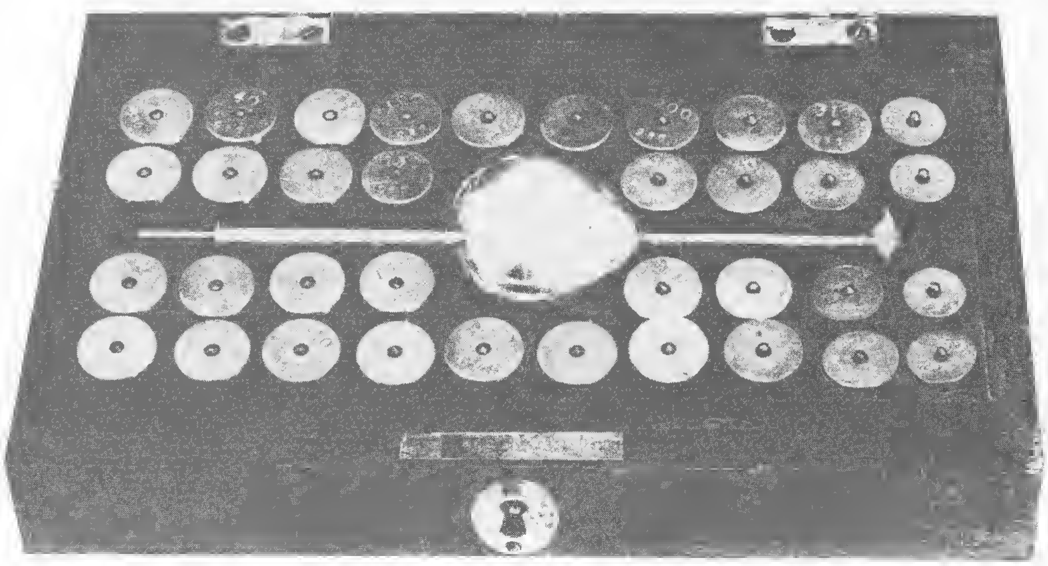


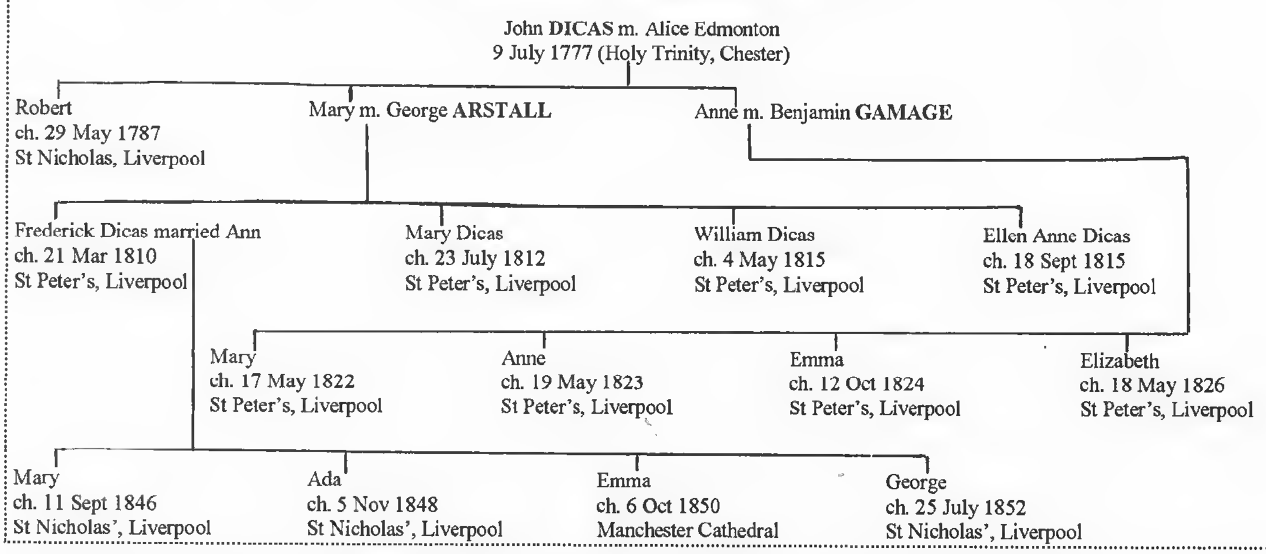
Fig 1. Dicas' hydrometer. The bulb was loaded, so that the hydrometer floated vertically in the liquid being tested. The discs were slipped onto the spike until a reading (0–10) could be taken on the graduated upper rod. The slide-rule is missing, which enabled readings to be adjusted to a standard temperature.

The design was fiddly to use, and the discs were easily lost.

By 1807 Mary Dicas was in partnership with George Arstall, a scale-beam maker who had his own business at Temple Court, while the Dicas manufactory was based on the North side of the Old Dock.[2] At some point they married, and four children were christened at St. Peter's Church, Liverpool, between 1810 and 1815. It is possible that the Ellen Arstall who ran the firm "Widow Arstall & Son" between 1835 and 1841 was the youngest of these. The eldest, Frederick Dicas Arstall, in due course also became a scale-maker, working in Manchester from 1838, and returning to Liverpool in 1851. With the redevelopment of the Old Dock area, starting about 1812 (it finally closed in 1826), the

manufacture of Dicas' hydrometers moved to Temple Court, from whence most of the instruments (being illegal for taxation purposes in the United Kingdom) were exported to the United States.

Dicas Family Tree (ex IGI, 1988)



Did Arstall find that he had married into a money-spinning export venture, which helped to carry his scale-beam manufacture, at a point when it was proving inferior to those of his competitors? This is perhaps an unfair question, when it appears that no signed pieces of his work survive in a public collection to permit any qualitative conclusions to be drawn. The first advertisements seemed innocuous enough, when they appeared in one of Liverpool's two thrice-weekly newspapers:

Liverpool Courier, 7 December 1808,

GEORGE ARSTALL
SCALE-BEAM MANUFACTURER, TEMPLE COURT

RETURNS his most grateful thanks to the Merchants, Brokers, Grocers, &c. of Liverpool, for the great encouragement he has met with since his commencement in the Scale-Beam Business, and for the very great preference given to those of his manufacture.

G.A. begs leave to [warn] them, and all whom it may concern, against purchasing Scale-Beams, that have not "Arstall" stamped in the *Iron* as there are now many imitations of Arstall's much improved Scale-Beams, which are found on examination very incorrect. The absolute necessity of having a correct Beam must be obvious to everyone.

Repeated on 14 December 1808. In March and April the following year, much the same advertisement appeared on 3 occasions, with the second paragraph phrased in stronger language:

Liverpool Courier, 29 March 1809

........G.A. Begs leave to caution all whom it may concern, that of late there have been a number of Scale-Beams made in imitation of those of his highly improved manufacture, which, on examination, prove very erroneous. The absolute necessity of having a correct Scale-Beam must be obvious to everyone.

To be LET or SOLD, a HOUSE and SHOP on the north side of the Old Dock, Liverpool, in excellent repair: a very suitable situation for a Grocer, Draper, Druggist, &c. For farther particulars inquire of G. Arstall, No. 7, north side of the Old Dock. *(One concern)*

Repeated 19 April 1809: and 12 April 1809 without the last paragraph This came at a time of rapid growth of Liverpool's population, and expansion of its potential as a port; consequently, much work was going on in the dock area, and it was a good idea to move out of premises there before they were swept away by development.[3]

Fig. 2. A large beam with scales (platforms) made of wood strongly bound with iron. The chains were iron as the capacity went from 3 cwt. (152 kilo) to 1 Ton (1018 kilo). The beam could be supplied with various ends, the cheapest being 'Round ends' (see inset), with 'Square ends' for 2% more (see Fig. 4) or with 'Dutch ends' for 7% more (see Fig. 3). Decoration added further to the cost. 'Superior painting' added another 31% to the basic cost, and 'Superior gilt' added 36%! So the smallest basic version cost £2.14s, and the largest, most elaborate version cost £20, about 1830.

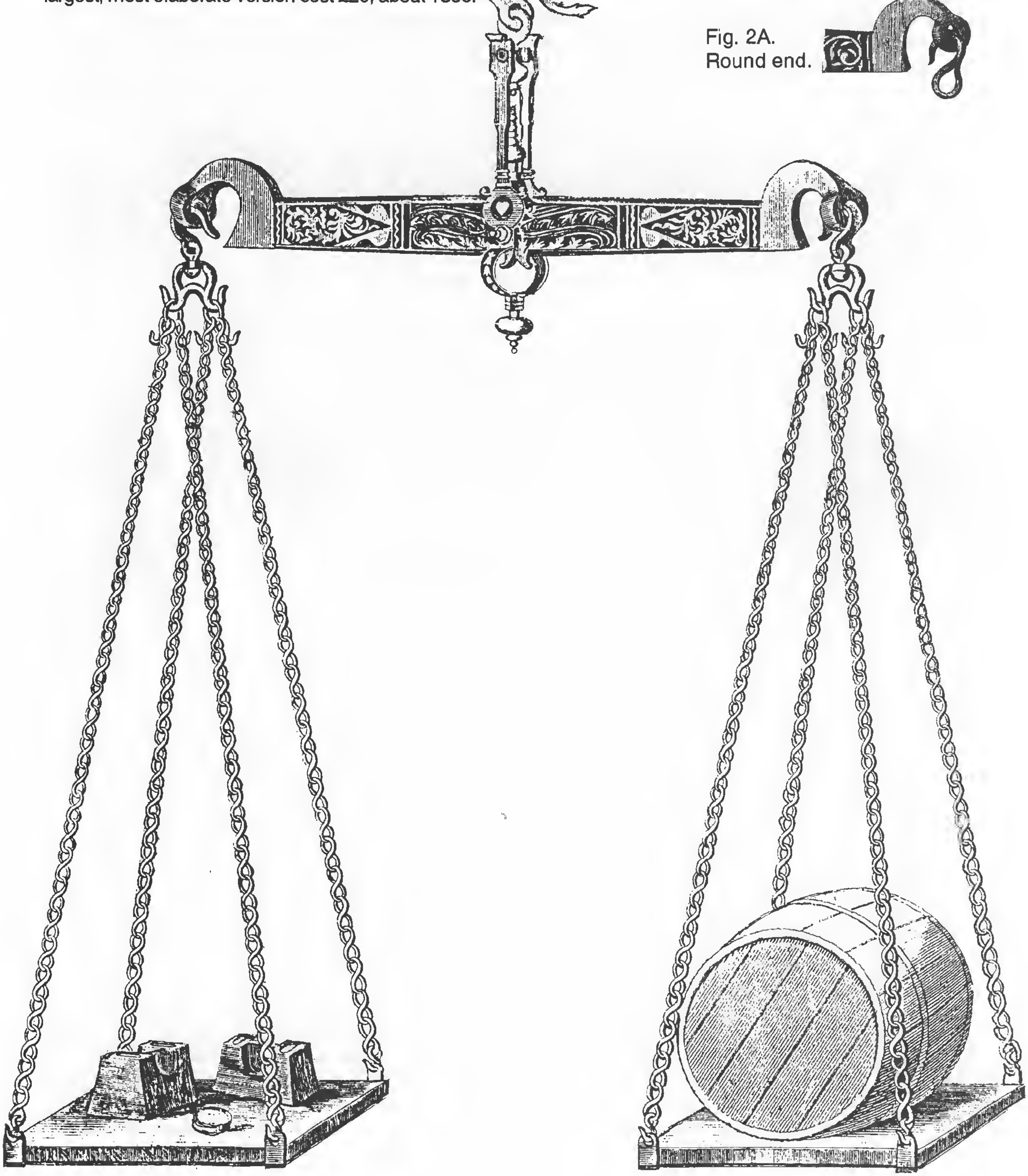


Fig. 2A.
Round end.

On 17 May, a furious response to Arstall's charge of 'erroneous' beams appeared in the *Courier*, signed by six tradesmen concerned with the sale of scale-beams in the area, and indicating that these advertisements had also appeared in the rival local paper, Gore's *General Advertiser*, as well as in the *Courier*:

Liverpool Courier, 17 May 1809:

REPEATED Advertisements having recently appeared in Gore's General Advertiser, inserted by Mr George Arstall, Scale Beam Manufacturer, who declares to the public that "the Scale Beams of his manufacture excel all others that have been offered to the Public, in accuracy, convenience, portableness, and the length of time they keep in excellent order."

We, the undersigned, beg leave to assure our friends and the public that Mr Arstall has no method whatever of making Scale Beams than what has been practised by us for many years; and that we continue to manufacture Scale Beams on the best and most approved principles, which we warrant to be as correct as those made by Mr. A. It must be obvious to all, that [no] ornamental painting and gilding can add to (more than) accuracy of a Scale Beam, than an exorbitant charge can demonstrate its excellence. If Mr Arstall vainly imagines that the Beams of his manufacture excel all others in point of accuracy, or that he has even made the smallest improvement in the construction of Beams, we shall be glad to have an opportunity of convincing him of his errors.

THOS. MOSELEY BENNET	HENRY WRIGHT	RICHARD RIMMER
LONGTON and HARRISON	DUTTON and MOSS	ARTHUR LITTLEJOHN

These businesses claimed *'that we continue to manufacture Scale Beams on the best and most approved principles'*: that year, all the firms were listed as 'ironmongers' in Gore's *Liverpool Directory*.[4]

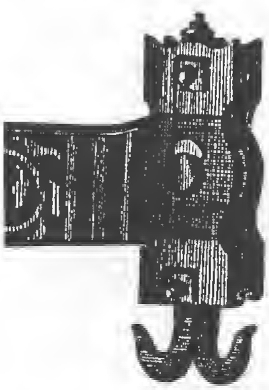
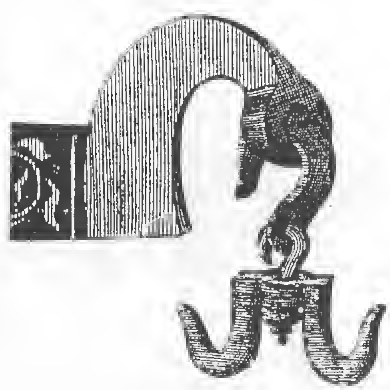


Fig. 3. A Dutch end, made for extremely heavy-duty scales that were used in dirty environments to weigh loads that were jolted onto the flat platform. The end was held together by massive bolts that could be removed easily to replace damaged knives. Dutch ends were shown in Diderot's Encyclopaedia of 1751. Thomas Beach's catalogue, [undated; he retired in 1797] shows Dutch ends on his 1 Ton (1018 kilo) capacity beam.

Fig. 4. A heavy-duty swan-neck end for loads up to about 1 ton, with a 'Square end', that is, a double hook to take two looped-over chains that supported the four corners of a platform.



But George Arstall apparently felt that such a retort could not go unchallenged, and there appeared:

Liverpool Courier, 24 May 1809:

AN advertisement appeared in the LIVERPOOL COURIER of Wednesday last, signed by a few of the ironmongers of this town, which GEORGE ARSTALL, Scale-Beam Manufacturer, cannot suffer to pass without making a few remarks thereon. The undersigned in the above-mentioned advertisement have very erroneously declared that G.A. has no method whatever of making Scale Beams than what has been practised by them for many years. With respect to the principles and accuracy, G.A. can, at any time prove the superiority of his Scale-Beams in such a manner as to admit of no controversy; and also the inaccuracy of all others made in Liverpool. It is certainly an insult on the judgement of the public, for those people to inform them that the painting and gilding cannot add to their accuracy: every one possessed of common sense knows that the gilding has nothing to do with the intrinsic value; but few Gentlemen wish to have a Scale Beam which looks as if it was just come from under a sledge hammer. G.A. also has to observe, that if he was to make Scale Beams in the same manner as they do he could sell them for less than they charge. He must take the opportunity of informing them, they have subjected themselves to a prosecution, as it is a libel on his character to say that he makes an exorbitant charge. Those persons should first correct their own errors before they talk of convincing others of theirs.

Of the following [counts, G.A.] will leave the public to judge. One of the undersigned in the above-mentioned advertisement, Mr Henry Wright, purchased a Scale Beam from G.A. for the purpose of weighing his own goods; several years after he sent it to G.A. to be repaired, when he lived 10 miles from Liverpool: the same is now seen in his shop: and although he says that the ornamental painting and gilding cannot add to the accuracy of a Scale Beam, yet he has thought it necessary to gild his own name upon it. It is evident he prefers G.A.'s manufacture for his own use, yet he advertises that he continues to make Scale Beams for the public as correct as those made by Mr A. Mr Richard Rimmer formerly made Scale Beams on the same plan as those made by Mr H. Wright, commonly called Dutch-ends, but knowing that

those of G.A.'s manufacture being so much more approved of, he has adopted the outward plan (only). Mr Rimmer's foreman being asked the reason for endeavouring to imitate G.A.'s plan, answered, because they make better: a proof of the disapproval of the Scale Beams made by the Ironmongers of Liverpool.
G.A. has at his Manufactory, Temple-court, a cart-load of Scale Beams of the above description, with the name stamped in the iron, many of which are nearly new, and which have been sold to him as old iron, the same having been replaced by those of his manufacture.
N.B. It will be recollected in G.A.'s former advertisement he mentioned no name, neither did he allude to anyone in particular; it was a duty incumbent upon him, for the present favours received from the public, to caution them against purchasing such Scale Beams as were not fit for use; but in the present case he thinks it highly necessary to expose the authors of the before-mentioned advertisement, in the manner they deserve.

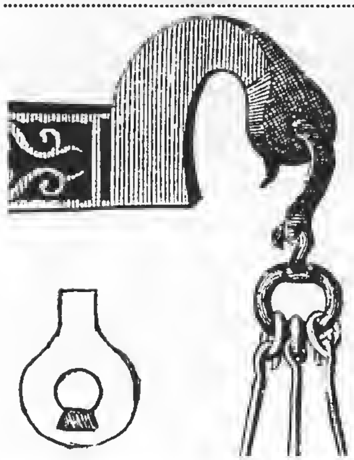


Fig. 5. A swan-neck end with a 'Bright Ball' fitting. This refers to the ring that took the rods, links or cords. This end was used on beams between 18 inch (45 cm) and 72 inch (360 cm) long, made for heavy trade weighing. The knife was either just a filed part of the beam, or, on superior beams, a wedge of hardened steel let into the end. The beam was 'Painted', so was black with red curls. This finish rarely survives.

Fig. 6. This rugged 'Box End' was used on superior beams that cost over twice as much as the previous version. The bearing shows as a pale square on the outside of the cheek. The handsome finials were screwed into the Box, using hand-filed screws.

In the same newspaper column, directly below Arstall's diatribe appeared a defence by Henry Wright, who links George Arstall with a 'Mr Arstall, senior, of Blackbrook', a village near Prescot, (ten miles west of Liverpool,) who was presumably his father, or possibly an elder brother.[5] Wright also accuses George Arstall of plagiarism, in that 'his *Highly-Improved* Swan-necked Beam.....is an exact copy of Mr De Grave's, of London, such as has been sent to Liverpool 20 years ago'. The highly-regarded and long-lived DeGrave business specialised in the manufacture of weights, measures and balances.[6]

Liverpool Courier, 24 May, 1809

MR ARSTALL, junior, having again attempted to obtrude his egregious nostrums on the Public, though the medium of Mr Gore's paper of the 18th inst., by artifice, subterfuge, duplicity, and mean equivocation, I am imperiously called upon to state to my Friends and the Public in General, (*in palpable contradiction to Mr Arstall's [claim]*) that *I never purchased a beam from him of any description.* It is true that I once sent a small Beam to Mr Arstall, senior, of Blackbrook, to be repaired, merely because my own workman was then in Manchester, which Beam my man has since adjusted. If it were true, as Mr Arstall wishes the Public to believe, that his mechanical genius and inventive powers have led him to a discovery of some new improvement in the outward form or internal mysterious part of a simple equalised Lever, called, ages ago, a Common Swan-necked Scale-beam, I say, if these assertions be true, let him honestly and candidly put the matter past all controversy, by bringing forward , for public experiment, the best Beam he can possibly make in any form he pleases, either Box-ended, Dutch-ended, or his *Highly-improved* Swan-necked Beam, which is an exact copy of Mr De Grave's of London, such as been sent to Liverpool 20 years ago, and I will meet him with a Dutch-ended Beam of my own manufacture, even an old one, (which Mr Arstall has considered in his interest to condemn as erroneous and unserviceable). Then let the result unmask the deceiver, which ever he may prove to be.
Liverpool, May 20, 1809 HENRY WRIGHT

By now, George Arstall seems to have lost his temper, and wished to challenge Henry Wright in some public demonstration, perhaps in order to humiliate him: even if this occasion was not to prove as violent as his words (a duel with swords or pistols being illegal, and in any case, not a seemly resort for mere tradesmen).[7] However, it was Henry Wright who inserted the next instalment in the war of words:

Liverpool Courier, 7th June, 1809:

Copy of a LETTER received by HENRY WRIGHT from Mr GEORGE ARSTALL:-

Sir — Temple Court, 29th May 1809

I will meet you precisely at three o'clock this afternoon at the New Exchange, with a Scale Beam of my manufacture, capable of weighing 15 cwt. and upwards. If any of you Confederates, who signed the first advertisement, *dare* bring forward Scale Beams of their own make now is their time, and I will prove, to the Satisfaction of the Public, you are not capable of making a Scale Beam *correct* as those of my manufacture - I am, Sir, yours &c.

G. ARSTALL

H. WRIGHT takes this opportunity of informing the Public, that a similar challenge to the above appeared in Mr Gore's paper of the 25th ult. which was by him promptly accepted and fairly met, and that the result proved disadvantageous to Mr Arstall, inasmuch as he has not been able either to substantiate the superiority of his own Beams "with respect to principles and accuracy" or "the inaccuracy of all other Beams made in Liverpool."

If Mr Arstall's productions have proved anything, it is that he has been superior in arrogance without being particularly useful. But Mr A. accuses me of "envy and malice", and of attempting to "impress the Public with an unfavourable opinion of the Scale Beams of his manufacture." Had I valued Mr A.'s Beams as "old iron", as he has done one of mine, the imputation might perhaps have been just: but as that has never been the case, the charge of "envy and malice" recoils upon himself. Nor is a good reason why it ought to recoil wanting the identical Scale Beam which he had condemned as erroneous and unserviceable, as old iron, and made by a "common blacksmith", has been put in competition with a new one of his own manufacture, and declared to be in point of accuracy, equal to the highly improved "Swan Neck", which had never been in use. Is this proving all that he asserted? Or ought his assertions at all to be credited, when he says that the Beam which I produced in competition is worth only one penny per pound, or seven shillings and sixpence in the whole; while he, at the same time, with unequalled effrontery, asks eighteen or twenty guineas for his own?

With respect to the Scale Beam which Mr A. repeats I purchased from him for my own use, I have made oath before Mr Golightly "that I have never purchased a Scale Beam of any description from either Mr A. Senior or Junior, or any person for me." When Mr A. informs me that he has no occasion to say anything "respecting the accuracy &c. &c. of his Scale Beams", I agree with him; when he tells me that he will teach me to "distinguish between Scale Beams made on the mathematical principles" and those made by "common blacksmiths," I smile at his ignorance; but when he says that my advertisements have procured him several additional orders, (which he were never likely to derive from his own), I rejoice with him. Justice to myself requires me thus publicly to notice the false assertions and weak conduct of Mr A.; having done which, I shall decline any further controversy.

H.W. respectfully informs his Friends and the Public that he continues to make SCALE BEAMS of every description, warranted correct, on his usual moderate terms.

BOROUGH OF LIVERPOOL

I, HENRY WRIGHT, do make oath, that I never purchased a Beam of any description from either Mr ARSTALL, Senior or Junior, nor any person for me.

HENRY WRIGHT

Sworn at Liverpool, before me, this 6th day of June, 1809. — THOS. GOLIGHTLY

But swearing on oath before a lawyer was not enough for George Arstall, and he gave his own version of the competition between the scale-beams made by the rival establishments, in which the Arstall-made beam apparently won:

Liverpool Courier, 21 June 1809:

G. ARSTALL conceives no apology will be necessary for his intruding himself upon the attention of those who have lately seen in this, and Mr Gore's paper, an advertisement of Mr Wright's, alluding to experiments on the merits of Scale Beams, with other extraneous matter, the stile and design of which sufficiently evince the present temper of the author: whether of a superior or lesser degree of arrogance and malignity than what he imputes to others, the Public will judge. It might be supposed, that a really successful competitor would have been in better humour, at least before the Public. *He has stated* that G.A. has not been able, on a fair trial, to substantiate the superior excellence of his own Beams - - of this the Public will judge from a few matters of fact. The Scale Beam I brought forward proved in *every respect correct*: that of my opponent's being erroneous, both in make and principle, became so jammed in the main centre, it could not be freed without his man fetching a piece of iron to give it liberty: when this was accomplished, two equal weights of 5 cwt. each, being suspended which ever way the

Beam started it descended with velocity, so that it was impossible accurately to ascertain by such a Beam the equality or inequality of the said weights. On the contrary, the Beam I produced, when 5 cwt. was suspended at each end, moved in any direction by the addition of drachms, and with 2 cwt. with 1 drachm only. Is this result to my disadvantage? Mr W. himself certainly did not think so at the time, or he would never have made the poor apology of *his Scale Beam being an old one, and he had not time to make a new one.*

In answer to an intimation respecting charges of prices, I can produce a respectable witness, if necessary, who will corroborate my former assertions. A gentleman paid Mr W. ten pounds for a Box-end Scale Beam, which soon afterwards came to me for repairs, but was found so generally defective it could only be *mended by a new one*, for which *I charged only six guineas*: this I mention as one out of numerous instances I could point out, and may some time or other make public. Is it not reasonable to suppose that a person who pays the most unremitting personal attention to one branch of business, and trusts no workmen with the adjusting of his machines, should [be in]competent to assert that, out of many hundreds of Beams he has sold, not one of them was found faulty! Now for Mr W.'s oath, a serious act, no doubt, performed before Mr Golightly, but it proves nothing in his favour; it was the *use* of a Scale Beam of my manufacture *in preference to his own* and which was sent to me for repair, which I make an argument in favour of my workmanship. It may be true that he himself did not ever buy one from me, as I had asserted, it seems that a brother of Mr H. Wright's had formerly occupied the same shop, of which *I was utterly unaware*, and must repeat my assertion, that a Mr Wright, No. 11 Castle Street, did purchase a Beam from me when I lived at Blackbrook; which Beam has been several years in the said shop, from whence I have had it to repair, at the request of the *general occupier*.

I shall now leave this gentleman to the pleasure of his own reflections, fully satisfied that, notwithstanding the formidable combination, stimulated by jealousy &c to injure my reputation, in which he has performed so conspicuous a part, the *superior excellence* of my manufacture will continue to prove, as it has hitherto done, the best evidence in my favour, the best apology for my public advertisement, and surest pledge of that general public patronage, which will be ever more gratefully acknowledged by the Public's most obedient and very humble servant.

Scale Beam Manufactory GEORGE ARSTALL
Temple Court 20th June 1809

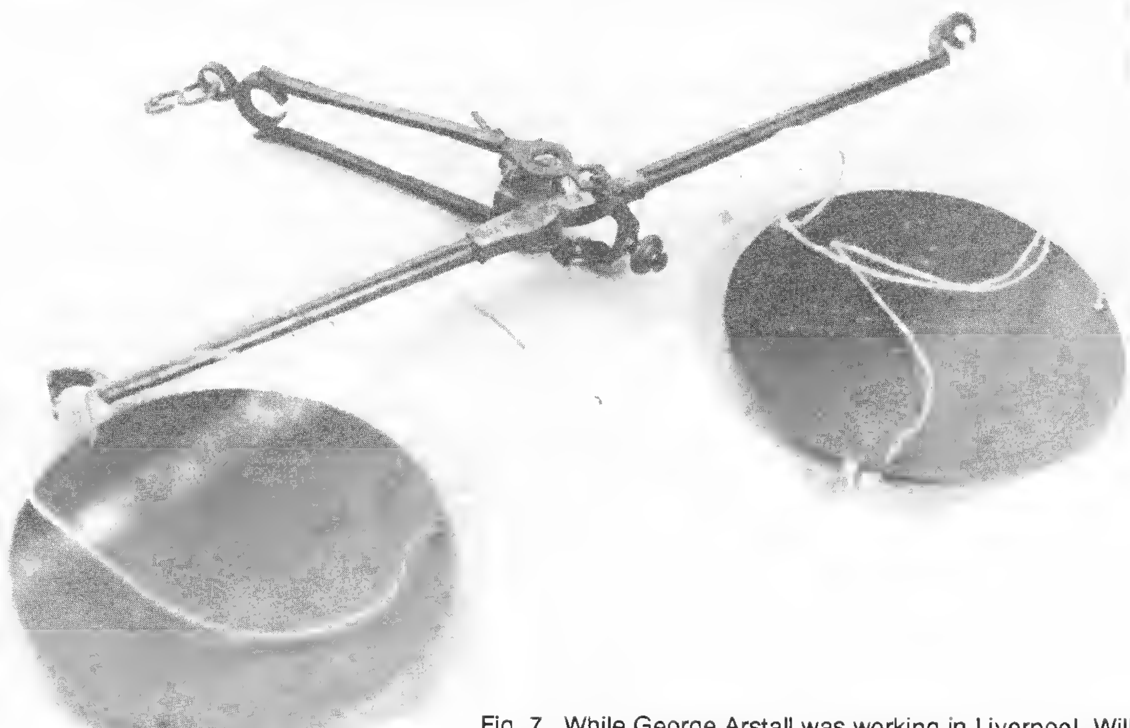
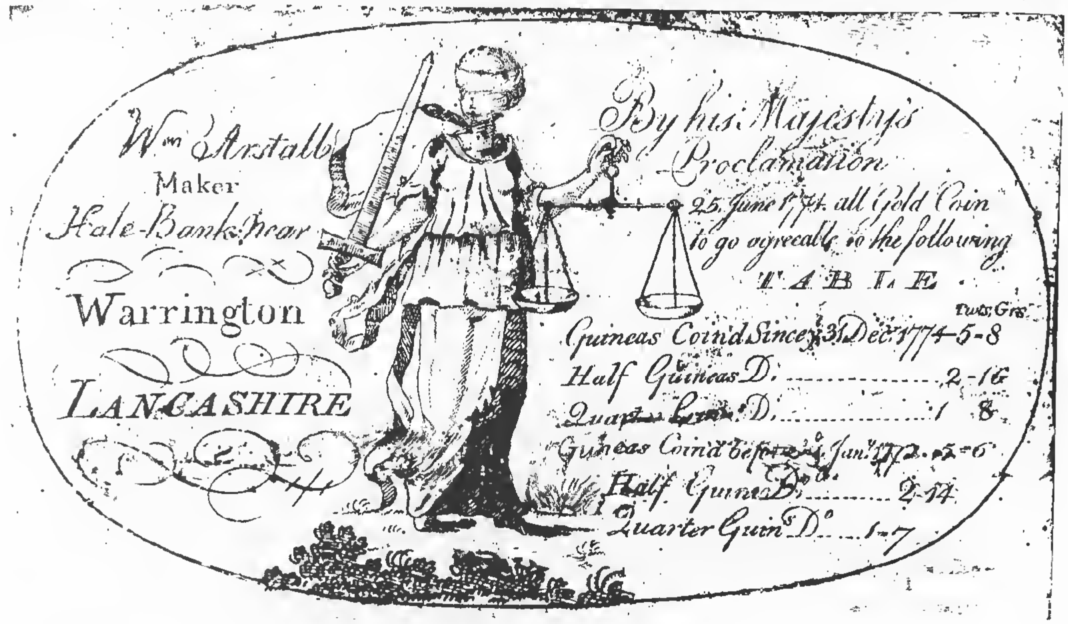


Fig. 7. While George Arstall was working in Liverpool, William Arstall was working in Blackbrook. One of them stamped 'ARSTALL' in the centre of the beam, on both sides. The shears-design is very unusual, whereas the shears of the scale on the Cover is conventional. The pointer is broken and the original cords are missing. It was in a cut-from-solid box like the one on the Cover when it was bought from an antique dealer, but the beam fitted so badly into the box that it was probably not the original box.

Fig. 8. The label of the scale-box on the Cover. It is dark, wrinkled and dirty, so it is difficult to read. The label refers to the Proclamation of 25 June 1774, which permitted the use of very light coins (temporarily, from 1774 to 1776), as long as the coins had been minted before 1772. As the label did not refer to the $^{1}/_{3}$ guinea coin, which was first minted in 1798, the label was probably used before 1798. The use of the symbol of Justice, blind-folded, holding scales in one hand and a sword in the other, was a traditional sign outside the shop of scale-makers.



So Henry Wright felt obliged to give his own version of the 'facts', at even greater length, and further detail:

Liverpool Courier, 5 July 1809:

SCALE BEAMS

I did expect that Mr ARSTALL would have been perfectly satisfied with my statement of facts in this paper of the 5th June, respecting the trial of the Scale Beams, and that I should not have had to trouble the Public anymore on the same subject; but Mr A. having again attempted to prejudice the Public, *by false assertion* in favour of his and against my Scale Beams, I beg leave once more to set him right; and as proof on oath does not suit him, I will try what reference to his own friends and other respectable persons will do. In his statement of the 21st ult. Mr A. asserts, in the trial of Scale Beams, my man used an Iron Bar to relieve the main centre. Had the man held in his hand a sledge hammer, I have no doubt but he would have informed the Public it was to relieve some deficiency in the Beam; but he does not say, that he, Mr A., used a piece of iron with all his force, in every part of my Beam, to injure its acting; not did he desist from this application till his fried Mr Hoskins observed, "you see Mr A. that you do not at all alter the Beam!"

Mr A. says, it might be supposed, that a really successful competitor would have been in better humour, at least before the Public. But has Mr A. told us in what kind of a humour he was when he called all those that were present a set of *blackguards*? Mr A. frequently said, if I met him with a Scale Beam he would make it the worst day's work I ever did, that he would expose my ignorance in the mathematical principles of a Scale Beam. The first I have not as yet any occasion to repeat, and in the last he completely failed. I have no doubt but his own friends will admit that he exposed his own (not my) ignorance, when he refused to reverse the ends of the Beam with the same weights; nor would he admit of it until over-ruled by his own friends. Any person that has the least knowledge of a Scale Beam knows that it is impossible to try its accuracy without reversing the ends. I am afraid Mr A. has a short memory: he must have forgot himself when he says that I made a poor apology when I said "my Scale Beam was an old one, and that I had not time to make a new one." If he will look into this Paper of the 24th May, he will find that I challenged to meet him with an old Beam, which he had condemned as worth nothing but old iron, and only worth 1d. per lb.; surely no apology was necessary, when this very old Beam, worth only 1d. per lb. was allowed, by his friend Mr Hoskins, to be equally *as correct* as his new one, for which he asks 20 guineas.

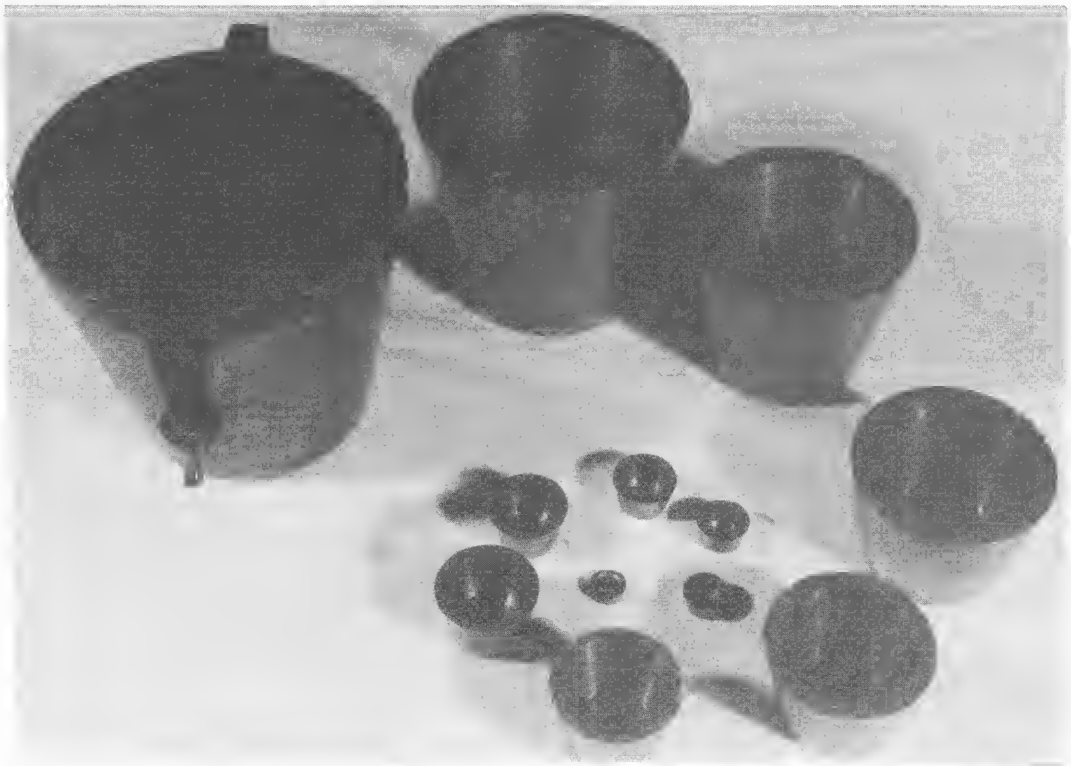


Fig. 9. A set of nesting weights made by 'Arstall' in 1821. Which Arstall? Because the weights were for the use of Inspectors of W & M, they were of the highest quality, and finely adjusted at the Exchequer in London. Together the weights weighed 256 Troy oz, so the largest one weighed 128 oz, then 64, 32, 16, 8, 4, 2, 1 ½ and two ¼ oz. Photo Martin Suggett

I was at a loss, until within these few days, at a loss to know Mr A.'s reasons for condemning all Scale Beams not of his own manufacture, as they must be upon a very bad principle indeed that they cannot be adjusted; but the reason is now obvious: a few days ago a respectable Broker called upon Mr A. to purchase some of those Beams which have been sold to him as old iron, and for which he had substituted Beams of his own manufacture. This old iron, it appears, was very much improved in Mr A.'s opinion, as he asked the Gentleman 6d. per lb. for them, and 10d. if adjusted. *Is this the manner in which Mr A. trusts the Public and thanks them for their favour?* Mr A.'s manufactory must have something magical in it, as it does not only improve the old Beams, but the principle. By lying there a short time, he admits they may be adjusted. The serious act on which Mr A. comments so much, performed before Mr Golightly, has made him confess that he has, although warned to the contrary, persisted in a falsehood; he has now found out, that it was not me, but a Brother of mine, that occupied the same shop, and now repeats his assertion that a Mr Wright, No. 11 Castle-street, did purchase a Beam from him. I am at a loss to know what he will next advance? If he will call on Mr Elias Joseph, my landlord, Mr J. will tell him, that no brother of mine, or any person of the same name, ever occupied the shop I do, viz. No. 11 Castle-street. Mr A. to inform the Public how very reasonable he charges, tells them that he has substituted a Beam for which he charged only *six guineas*, in lieu of one of mine for which I charged then ten pounds; but to the discredit of Mr. A.'s veracity, I have to observe that the Beam he alluded to was only charged £7, and [a] Beam for which Mr A. has charged 6 guineas, which is exactly 3 s per lb. I will pledge myself to equal for two guineas, which is only 1s. per lb.; and the Public will perhaps be astonished when they are informed, that

Fig. 10. The lid of the set above, showing the 'CORPORATION OF LIVERPOOL' round the Liver Bird, with 'Arstall fecit' below Photo M Suggett

this Beam, which Mr A. in his last appeal to his friends states could only be repaired by a new one, has since been repaired by Mr A. himself, and is now in the possession of, and used by the same person to whom he sold the new one above alluded to. Anything I have advanced I am willing to affirm upon oath; and what Mr A. may hereafter state, except on oath, I shall consider unworthy my notice, as against such antagonists truth I wage [moral] war.

Liverpool, July 4, 1809 HENRY WRIGHT

Here the angry protagonists, no doubt very much out of pocket, ceased this sterile argument: one wonders whether business improved for either party, or if Liverpool readers were disgusted, amused or indifferent to this display of vented spleen.

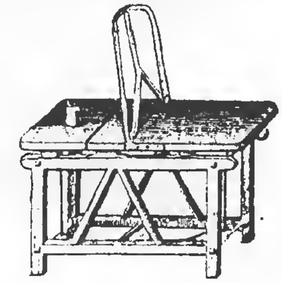
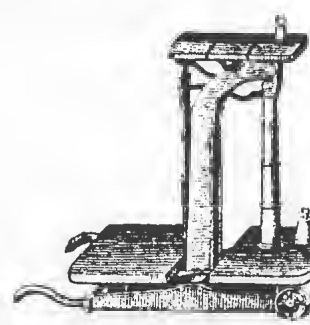


Fig. 11. George Arstall was not in Directories after 1821, but this advertisement was in Gore's Directory of Liverpool in 1839. 'Nearly sixty years' takes the firm back to about 1780. It is not known whether William or George Arstall was considered to have started the dynasty. The beam in the advert' is a trade beam with swan-neck ends and bright ball fittings. It would be most interesting to see a bankers' scale or a hydrostatic balance by Widow Arstall & Son. By 1839, 'Weighing Machines' commonly referred to roberval platform scales, as shown on p. 697 of EQM, and above and below this caption.



Acknowledgements:

I would like to thank Martin Suggett, Diana Crawforth-Hitchins, Dr Anita McConnell and Dr A D C Simpson for their assistance with this piece.

References:

1...For Mary Dicas, see A D Morrison-Low, Women in the Nineteenth-Century Scientific Instrument Trade, in Marina Benjamin (ed), *Science & Sensibility: Gender and Scientific Enquiry 1780-1945*, Oxford, 1991, p 98.

2...Addresses and trades for the Arstall and Dicas families, gleaned from Gore's Liverpool street directories, [and a few entries in B=Baines', C=Commercial, G=Gore's, H=Holden's, M=McCorquodale's, P=Pigot's,

and U=Underhill's,] are as follows:

Arstall, William

c. 1775, Hale-bank near Warrington (on coin-scale label)
1814 [C], scale maker, Black brook, Prescot
1816 [P], scale maker, Prescot
1817 [C], scale maker, Black brook, Prescot
1824 [B], scale maker, Sutton near Prescot
1826, will proved in Chester. Estate passed to Mary, his widow

Arstall, George

1807, scale beam & mathematical instrument maker, 7 North side Old Dock
1809, scale beam & mathematical instrument maker, 7 North side Old Dock
1809–1811, scale beam & mathematical instrument maker, Temple court
1810, scale beam maker & maker of Dicas' hydrometer, 29 Pembroke place and manufactory, 1 Temple court
1811, scale beam maker, and maker of Dicas' hydrometer, 29 Pembroke placo and manufactory, 1 Temple court
1811 [H], scale, beam & mathematical instrument maker, Temple court
1813, scale beam and maker of Dycas' hydrometer, 32 Pembroke place; manufactory, 1 Temple court
1814, scale beam maker, and maker of Dycas' hydrometer, 32 Pembroke place and manufactory, 1 Temple court
1814–1815, scale beam &c. maker, 1 Temple court
1816, scale beam maker, and maker of Dycas' hydrometer, 43 Pembroke place and manufactory, 1 Temple lane
1816 not in [C]
1816 [U], scale beam maker, & maker of Dygas' [sic] hydrometer, 43 Pembroke Place
1818 not in [P], [see Dicas, A.],
1821, scale beam maker, Bank buildings, 50 Castle street
1822, 1823, 1824, 1825, 1827 not in [P], [B],

Arstall, Widow

1829, scale beam manufacturer, 33 Moorfields
1830 not in

Arstall, Widow & Son

1829, Scale maker, 33 Moorfields
1832, scale beam manufacturers, 37 Moorfields
1834 [P], scale beam manufacturer, 36 Moorfields, Liverpool & 1 Bradshaw Street, Manchester
1835, scale maker, 37 Moorfields
1837, scale maker, 37 Moorfields
1839, Scalemakers, 60 Cable street
1841–1849 inclusive, Scalebeam manufacturer, 26 & 28 Cable Street
1848–1851 inclusive [S], Scalemaker, 28 Cable St, Liverpool & 1 Bradshaw St, Manchester

Arstall, Ellen (Widow A. & Son)

1835, [no trade], 3 Juvenal street
1835, scale-beam & improved weighing machine manufacturers, 37 Moorfields
1837 not in [P]
1839, scale-beam & improved weighing machine manufacturers, 26 & 28 Cable street
1841, scale-beam & improved weighing machine manufacturers, 26 & 28 Cable street

Arstall, Widow & Son [Ellen & Frederick]

1843, scale-beam & improved weighing machine manufacturers, 26 & 28 Cable street
1844, scale-beam & improved weighing-machine mfrs, 26 & 28 Cable street
1845, scale-beam & improved weighing machine manufacturers, 26 & 28 Cable street
1846, scale-beam makers, 28 Cable street
1847, scale-beam & improved weighing machine manufacturers, 26 & 28 Cable street
1848 [M], scale-beam & improved weighing machine manufacturers, 26 & 28 Cable street
1848 not in [S]
1849, scale-beam & improved weighing machine manufacturers, 26 & 28 Cable street

Arstall, Frederick

1838 [P], scalemaker, 5 Bradshaw Street, Manchester
1841 [P], 7 Bradshaw Street, Shudehill, Manchester
1843 [S], scalemaker, 7 Bradshaw Street, Shudehill, Manchester
1851, scale-beam & improved weighing machine mfrs., shop 5A Thomas Street and workshop 16 Whitelfield Lane, Everton
1852, scale beam mfr, 5 Thomas street
1853, scale-beam & improved weighing machine manufacturers, shop 5A Thomas Street

Dicas, John

1774–1787, liquor merchant
1790, mathematical instrument maker & navigation shop, 27 Pool Lane
1794, mathematical instrument maker, 27 Pool Lane
1796, patent hydrometer & mathematical instrument maker, 27 Pool Lane
1799, mathematical instrument maker, 27 Pool Lane

Dicas, Mary

1800, patent hydrometer & mathematical instrument maker, 27 Pool Lane
1803, patent hydrometer & mathematical instrument maker, 7 North Side Old Dock, Strand St
1804, hydrometer & mathematical instrument maker, 7 North End Old Dock
1805, patent hydrometer & mathematical instrument maker, 7 North Side Old Dock

1805–1807, mathematical instrument maker, 7 Old Dock

Dicas & Arstall

1807, patent hydrometer & mathematical instrument maker, 8 North Side Old Dock

Dicas, Mary

1808, mathematical instrument maker, 7 Old Dock

Dicar & Arstell [sic]

1809, patent hydrometer makers, 8 North Side Old Dock
1809–1811, patent hydrometer makers, 8 North Side Old Dock
1810, [see Arstall, above], 7 North End Old Dock
1811 [H], patent hydrometer makers, 7 North Side Old Dock
[see Arstall, George]

Dicas, A.

1818 [P], patent hydrometer maker, Bronte Street

Dicas, Anne

1818, patent hydrometer maker, 20 Trowbridge
1821–1822, patent hydrometer manufacturer, 83 Brownlow Hill

Dicas' Patent Hydrometer Manufactory [see Gamage, Benjamin]

1832, 17 Clarence Street
1835–1837, 133 Brownlow Hill
In about 1823, Ann Dicas married Benjamin Gammage or Gamage:

Gamage, Benjamin [see Dicas' Patent Hydrometer Manufactory]

1823–1851, hydrometer maker & stationer, various addresses in Liverpool
1853, book keeper, 57 Brownlow Street

A 'Thomas Arstall, scale beam maker' appeared in directories; however, no conclusive evidence has been found to connect Thomas with George Arstall's family of scale-beam makers.

Arstall, Thomas

1811 [H] [P], Scale-beam maker, 25 Market Place, Manchester
1818 [P], Scale-beam maker, 25 Market Place, Manchester
1824 [B], Superintendent of W & M, St George's Market, (top of Pool Lane) & St. John's Market, Liverpool
1824 [B], inspector of W & M, 36 Duncan Street, East Liverpool
1844 [P], inspector of W & M, 115 Scotland street; house 13 Pembroke place, Liverpool

3...For a discussion of contemporary pressures, see Sheila Marriner *The Economic and Social Development of Merseyside,* London, 1982.

4...Gore's *Directory of Liverpool for 1810,* Liverpool, 1809, passim:
Thomas Mosley Bennett, ironfounder, house; 8, ironfoundries; 10 Harrington St, and 2 Batchelor Street
Henry Wright, ironmonger, 10 Castle Street
Longton & Harrison, ironmongers, 29 Castle Street, warehouse; 21 Castleditch
Dutton & Moss, ironmongers, 39 Castle Street
Arthur Littlejohn, ironmonger, 20 Bold Street
Richard Rimmer, ironmonger, 4 Mount Vernon. Shops at 24 & 25 Northside Old Dock
Richard Rimmer, smith and smithy, 63 Tythebarn Street

Editor:- More can be added to the life-histories of some of these men and their sons, by using Baines' Directory of Liverpool for 1824:
Thomas Mosley Bennett, ironfounder, 47 Sir Thomas Buildings
James Longton & Son, ironmongers, 25 Castle Ditch
Richard & Nicholas Harrison, ironmongers & ships' smiths, 10 Bird St & 6 Ansdell St
Moss & Whalley, furnishing ironmongers, tinners & braziers, 70 Paradise Street
Arthur Littlejohn, ironmonger & Lancashire file & tool maker, 98 Bold Street
Thomas John Rimmer, ironmonger, 35 London Road
Richard Rimmer & Son, ironmerchant, 25 Northside Old Dock & house 6 Mount Vernon Street

Editor:- Littlejohn & Co., weighing machine and scales maker, were at 31, St George's Street in *Kelly's Directory of 1858*, and J S Rimmer was listed as a scale-maker at Porter Street in the *Inspectors' Handbook of 1910*.

5...Biographical notes on William Arstall of Black-brook, near Prescot, are given by Michael A Crawforth, *Weighing Coins: English folding gold balances of the 18th and 19th centuries,* London, 1979, p. 135-6.

6...Notes on the DeGrave business are to be found in Gloria Clifton, *Directory of British Scientific Instrument Makers* London, 1995, p. 81. Expanded from earlier research for Project SIMON by Michael and Diana Crawforth.

7...See V G Kiernan, *The Duel in European History: Honour and the Reign of Aristocracy,* Oxford, 1986, for an overview.

Weighing in the Early 14th Century

Weighing Practices in Scotland, England and the Cities of Northern Europe in the Early Fourteenth Century -Part 2

By A D C SIMPSON and R D CONNOR

The commercial memoranda of the Florentine mercantile agent Francesco Pegolotti, written in the early fourteenth century, are a rich source of information about the weight systems of international trade in northern Europe.[1] This trading activity forms an essential context for the investigation of English and Scottish medieval weights, and Pegolotti's data provide a valuable testing ground for a recent re-assessment of early English metrology.[2]

The Hundredweights

There are three important early English declarations which relate to the hundred-weight. The first is in the *Tractatus*, discussed in Part 1 of this article, where the hundred of the 25-shilling pound (the internal goods pound of 15 ounces) was 100 pounds, but:

... *a Hundred of Wax, Sugar, Pepper, Cinnamon, Nutmegs, and Allum, containeth Thirteen Stone and a Half, and every Stone Eight Pound* [13½ x 8 = 108]. *The Sum of Pounds in a Hundred, One hundred and eight Pounds* ...[3]

A very similar declaration is included in the legal code known as Fleta, of about 1290:

... *a hundred-weight of wax, sugar, pepper, cumin, almonds and wormwood contains 13½ stones, and each stone contains 8lb.*[4]

Essentially both say the same:

the appropriate hundredweight for these comparatively costly imported goods was one of 108 pounds. The pound was not defined, but it had a stone of only 8 pounds, and it is therefore unlike the normal English goods pound of 15 Cologne or Tower ounces.

Fig. 4. The geographical positions of the European trading centres discussed in this article.

However, a slightly later English document, the `*Ordinacio Facta de Modo Ponderandi per Balanciam*' of 1309 presents a different picture. Having mentioned wax, almonds, rice, copper and tin, the text goes on:

And that every hundred of such-like bulk heavy goods contains V^{xx}*xii* [5 x 20 + 12 = 112] *pounds. And every hundred of smallwares and spices such as ginger, saffron, sugar and such like which are sold by the pound contains V*^{xx}*iiii* [5 x 20 + 4 = 104] *pounds.*[5]

Here the goods previously considered appropriate for the 108-pound hundredweight have been divided into two categories. Heavy goods (which were not specifically mentioned earlier) were to be

weighed with a hundredweight of 112 pounds, and this category included wax and almonds. Higher value goods, now including spices which may earlier have been weighed by a hundredweight of 100 pounds, were to have a 104-pound hundredweight. Pegolotti confirmed the hundredweight for heavy-goods in London was 112 pounds [Peg, 255]. The inference is that the 108-pound hundredweight had been displaced in favour of those of 104 and 112 pounds between 1290 and 1309.

But the *Ordinacio* has a very specific context which requires some explanation. It was shown in Part 1 that attempts to enforce level-beam weighing at the King's Beam in London in 1257 were frustrated, but the `cloffe' allowance declared for moving to level-beam from inclined-beam weighing was four parts in a hundred. By the turn of the century there seems to have been general agreement about level-beam weighing for internal trade, but disagreement about the practice for imported goods. In 1303 Edward I proposed to extend to foreign merchants and strangers the privilege of weighing goods in the same manner as London merchants, but the City of London objected in 1305 that all goods coming to London had always been and were still weighed by inclined-beam, and noted that the agents of important households (of bishops, barons, etc.) also bought imported goods on the same basis.[6] The proposed privileges were cancelled in 1311, but perhaps only as a result of the new provisions of the *Ordinacio*, which stipulated level-beam weighing and did so by introducing a cloffe allowance. The important point, however, is that there were clearly differences between the operation of the internal market and the import market. It seems reasonable that these differences reflected the pattern in other trading centres and that broadly similar practices for weighing goods in bulk applied elsewhere.

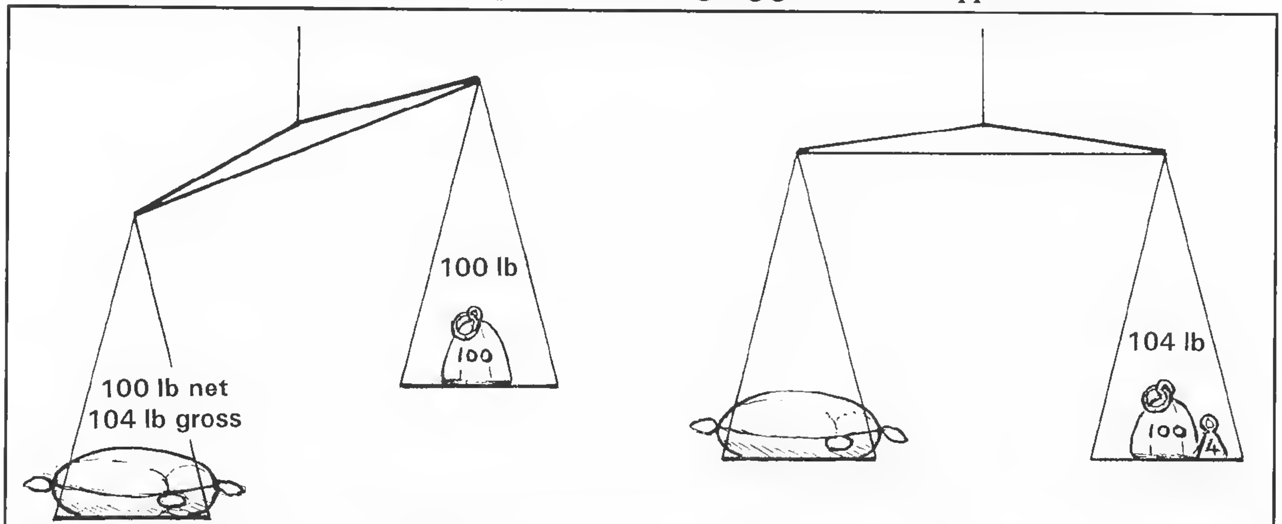


Fig. 5. The net and gross weight of a hundredweight of goods indicated by inclined and level beam.

The possibility of level-beam and inclined-beam weighing co-existing in the London wholesale markets over an extended period, and applying to different classes of goods, may help explain the relationship of the two types of stone weight (of 12 and 12½ pounds) defined in the *Tractatus*. In general, the implication of the *Tractatus* definition is that heavy or bulky domestic goods, for which inclined-beam weight might be expected at an early date, were weighed with the 12-pound stone; whereas more prized materials, which would of course be weighed by the balance, used the 12½-pound stone. The ratio of these two stones is 96:100, with the 12-pound stone being the smaller by 4 parts per hundred of the larger. In some instances both forms of stone might be permitted, and a portion of the *Tractatus* is indeed given over to describing the equivalence of two different *methods* of measuring the load of lead - these were by the tron, using 12-pound stones, and by division into weys, using 12½-pound stones. One can see how a parcel of goods could be weighed by inclined or level beam and the weight

expressed correctly as the same number of stones by choosing the stone appropriate to the method of weighing. We shall see below that the relationship between these two English stones is mirrored in the two principal Flemish pounds, which are also in the ratio 96:100.

The level beam, or balance, was required when accuracy was necessary, normally because comparatively valuable goods were being weighed in relatively small quantities. However, this was also the method adopted for the bulk weighing of wool by the king's officials when the Great Customs on English wool was imposed in the late thirteenth century, in order to ensure accuracy and acceptance. Initially many of the new regional wool beams (such as that at Kings Lynn) were constructed as steelyards, but by 1340 official wool beams were high-capacity balances. Thus the woolsack, previously given in the *Tractatus* as 350 pounds, was recorded by Pegolotti in the early fourteenth century at the official (level-beam) figure of 364 pounds [Peg, 254], although this would not preclude inclined-beam weighing in other circumstances. The added amount was merely the cloffe allowance of 4 parts in 100 (3.5 x 4 = 14).

The continued use of inclined-beam weighing at centres of international trade may be linked to the operation of a separate allowance. Many types of goods in transit required to be packed - spices, for example, were made up into canvas-wrapped bales and at initial purchase after import they could only be weighed conveniently when still packed. Weighings therefore had to incorporate a 'tare' allowance, a weight rebate to take account of packing materials. Weighing by inclined beam provided a convenient method of assessing the contents of packed consignments, but did so on the understanding that the packing materials added 4 parts per hundred to the weight. This conventional level of tare is the one recorded, for example, in the earliest printed arithmetic text in 1478.[7]

Thus, for example, a bale of goods weighing in total 104 pounds on a level beam, would be considered (by deducting the tare) to contain 100 saleable pounds capable of subdivision for retail; but if the package was weighed by inclined-beam the 100-pounds apparent weight (the level-beam weight reduced by the cloffe allowance) would represent the actual weight of the contents (fig. 5). Although the tare allowance was probably generous, any excess would provide notional compensation to the purchasing merchant for loss and spillage in the course of division: in other words it would represent additional potential profit for the importing merchant. The size of bales would be more likely to be loads rather than hundredweights, but the use of inclined-beam weighing would enable the weight of the contents to be assessed against the appropriate hundredweight for purchase.

The writer of the *Ordinacio* text was specific that the hundredweights *contained* the stated number of pounds and were therefore net weights, and it seems clear from Pegolotti's figures that he too was concerned very largely with the net weight of consignments. From the nature of the relationships discussed in Part 1 between various European weight systems we can tell that these were direct comparisons, so that these relationships were true equivalences, and by extrapolating from certain weighings described by Pegolotti (such as that of the woolsack in Bruges, described below) that the weights given at north European cities were generally by inclined beam. Our assumption, therefore, has been that there was consistent practice at these trading centres for goods at import or export, and that Pegolotti's interest related to transactions where bulk trading was done by inclined-beam as a means of making tare adjustment to consignments of baled goods.

If we compare the London hundredweights given by Pegolotti, a significant feature emerges. The hundredweight of heavy goods pounds in London was 112 x 6,750 = 756,000 grains, exactly matching that of spices, at 104 x 7,269.23 = 756,000 grains.[8] It was also the weight of 100 16-ounce Paris pounds (at 7,560 grains per pound), and Pegolotti noted that this was the Paris

hundred, with the load as 350 pounds [Peg, 236]. It would appear therefore that there was a uniform hundredweight for London trade (although this was not applicable to wool), and that it was defined by external reference to a hundred (5 score) of Paris merchant pounds.

Applying this to goods reckoned by a hundred of 108 (as in Fleta), it follows that the size of the appropriate pound is 756,000 ÷ 108 = 7,000 grains. We will see below that a pound of this size was used in Pegolotti's time for weighing wool in Bruges (replacing earlier use of the commercial pound of 6,720 grains), where it appears to have operated as a heavy goods weight. This was presumably the same pound that was later to become well-known in England as the 'avoirdupois' pound: it is very familiar from sixteenth-century English references, and it is the current legal pound in Britain. In fact, late-thirteenth-century English documents and the Scottish Assize of David (whose modified form dates from the mid-fourteenth century) reveal the use of this pound for wool weighing, so it must now be appreciated that the 7,000-grain pound formed an integral component of English and Scottish metrology from an early period. (However, since the term 'avoirdupois', and early English equivalents such as 'averdepois' and 'haberty poie', refers to a class of weighing rather than to a specific heavy goods pound, we must be careful not to infer that it invariably means the 7,000-grain pound.)

Thus, in the specific case of trading in London, the weights that can be derived from Pegolotti's data show that what have previously been considered as three separate hundredweights - of 104, 108 and 112 pounds - are actually all of the same mass but are divided into different pounds.[9] Pegolotti made it clear that this same hundredweight was in use in Paris, and it seems inescapable that this was why the London hundredweight was defined at this level. (It is of course possible that there were also other current hundredweights in Paris, perhaps involving the older 15-ounce internal goods pound.) There is an obvious practical advantage to ship-masters who required to distribute the ship's burden, of using standard hundredweights which were independent of the type of goods carried.

But this was not the only hundredweight involved in London trade in Pegolotti's time - wool was measured in weight units that derived from a larger hundredweight of 806,400 grains. The English wool pound, of which there were 112 in this hundredweight, was larger than the goods pound, and it is shown below to have been 7,200 grains. This larger hundredweight can be seen to be 120 (a long hundred) of the 6,720-grain merchant pounds of Bruges, the market through which much of English export wool passed; it is likely that this was an earlier and independent hundredweight dictated by Flemish commercial pressure. The special status of wool in the English economy - as a principal source of royal revenue, with its measurement in the hands of royal officials - makes the continued use of units derived from a separate hundredweight understandable as an exception to the general hundredweight of London. It does, nonetheless, bring with it the caution that there may have been a number of earlier and displaced hundredweights using the long hundred multiple.

The practical trading divisions of the hundredweight were not the constituent pounds, but units of one-sixteenth, which are often referred to as 'nails' or 'cloves'. In fact Pegolotti did not record the working divisions of hundredweights of goods (which he defined in pounds), and he reserved the use of the term 'clove' for wool. At first sight this is confusing because wool was sold by the 'sack' (a unit equivalent to the 'load') and not by the hundredweight. However the sack was normally considered to consist of a set number of cloves and these were the cloves (or working divisions) of the appropriate market hundredweight. Thus the Bruges clove for wool was of 6 pounds [Peg, 237], and it was derived from the hundredweight of 96 (16 x 6) of the pounds appropriate for wool weighing. We shall see below that wool was weighed in Pegolotti's time by the general goods pound of 7,000 grains in Bruges (where there was no separate wool pound as had been established in England). But 96 of these Flemish pounds was 672,000 grains, which was

100 of the earlier Bruges merchant pound of 6,720 grains. So the hundredweight in Bruges recorded by Pegolotti in the early fourteenth century was 100 Bruges merchant pounds. (It can now be seen why there is a possibility of an earlier definition at 120 Bruges merchant pounds, the clove of which is likely to have been the origin of the English wool clove.)

Although the Bruges hundredweight was different to those of Paris and London, it was still very closely related, since the Paris hundredweight of 756,000 grains was exactly $1^1/_8$ times the Bruges hundredweight.

The hundredweight in London can be seen to accommodate known hundreds of four different pounds - 100 Paris pounds (for fine goods), 104 Antwerp spice pounds (for spices), 108 Bruges goods pounds, and 112 English goods pounds. (There was also a coincidental factor of 105 for the English wool pound.) It is noticeable that there is no simple factor for the Bruges merchant pound of 6,720 grains (112½ in the hundredweight), which was apparently being progressively replaced by the pound of 7,000 grains. Nor is there an obvious pound of which a long hundred would make this hundredweight. This would require a pound of 6,300 grains, or 14 Cologne ounces; but although it seems plausible to introduce such a possibility, there is at present no independent evidence to support this.

A possible implication is that the Paris or London hundredweight was a relatively late introduction, devised to provide convenient trading equivalences and notably to incorporate the 'avoirdupois' pound of 7,000 grains. It should be noted that this pound is a reasonable approximation (at least in terms of bulk trading) to the Florentine *grosso* pound of 6,989 grains, which must have been a significant influence of north European trade in the thirteenth century, and we will return to this aspect shortly.

There is a range of problems which can be tackled progressively by extracting hundredweights and similar bulk units from Pegolotti's data. As an example, we have already noted that the load of spices was 350 pounds in Paris and 364 pounds in Antwerp and London [Peg, 257] - from which we can again obtain the London hundred for spice as 104 pounds and the pound as 7,269 grains. This Antwerp load was for external trade, but the equivalent load for the internal market in Antwerp and in Bruges was 400 pounds, where the pound was of 14 ounces [Peg, 237, 250]. If we assume that the mass of the load was the same, then the Antwerp and Bruges internal pounds are of 6,615 grains (7,560 x 350 ÷ 400 = 6,615). With 14 ounces to the pound, the ounce is 472½ grains, namely the Paris ounce. The two weights recorded earlier at the Gruuthuse Museum, Bruges, are presumably pounds from this series.[10]

The *Ordinacio* sought to introduce level-beam bulk weighing for the more valuable spices and some other materials at 104 pounds to the hundred. It might be expected that these would previously have been classified as fine materials which would be weighed by the Paris pound. One might therefore expect a hundredweight of 100 Paris pounds, baled at 104 pounds, to be weighed by inclined beam at 100 pounds and divided for resale into 100 units of one pound. If such a consignment was now weighed by level beam at 104 pounds, but still considered as a 104-pound hundredweight, then this is tantamount to weighing in terms of a smaller spice pound whose ratio to the Paris pound is 100:104. The net weight of such a consignment could still be determined by inclined beam as 104 spice pounds. The London and Antwerp spice pounds described by Pegolotti are unusual because they do not have a recognisable bullion-ounce basis, but on the other hand they are linked to the Paris pound by the cloffe allowance (7,269 : 7,560 = 100:104). Our suggestion is that they arose from applying a cloffe adjustment to the Paris pound - a change presumably accomplished in Antwerp before London. The use of such a pound at the wholesale level, in this case by the London Pepperers' Company, simplified the necessary calculation.

The Woolsack

One of the most significant bulk units for this early period was the woolsack. The sack was described in the version of the English *Tractatus* printed in the *Statutes of the Realm*, and in translation the clause reads as follows:

A Sack of wool ought to weigh 28 stone (that is 350 pounds), and in some parts 30 stone (that is 375 pounds), and they are the same according to the greater or lesser pound.[11]

This alerts us to the fact that there were at least two distinct pounds used for weighing wool in England in the thirteenth century. The weight had initially been given only in the appropriate stones, but explanations in terms of pounds were added between the lines of the original manuscript from which this printed text was taken, and this detail is not present on the other known versions. In this definition, the first pound is an English pound and the second is the Flemish merchant pound of 6,720 grains encountered earlier: the ratio of the pound sizes is 15:14, and only the pound of 6,720 grains (14 x 480) is compatible with this ratio (and with a later ratio of 96:100 relating it to a pound of which the sack contains 360 pounds). Taking the sack as 375 x 6,720 = 2,520,000 grains, and dividing this by 350, gives the English pound as 7,200 grains. This is 16 ounces of 450 grains (thus equivalent to 15 x 480), where the English goods pound is 15 ounces of 450 grains, giving it a character arguably similar to that of the Paris export pound of 16 ounces.

If the *Tractatus* is of about mid-thirteenth century, the weight values interlined in the text were probably added in the second half of the century, because by Pegolotti's time wool was already being weighed by the pound of 7,000 grains, in preference to that of 6,720 grains. This follows from his statements that the sack in Bruges was the same as that in England, and that the former was of 60 cloves, each of 6 pounds, making a total of 360 pounds [Peg, 245, 237]. Thus the pound used in Bruges for wool was 2,520,000 ÷ 360 = 7,000 grains. The Assize of David of Scotland recorded the stone as 15 pounds and the wey (or half sack) as 12 stone - giving the sack as 15 x 24 = 360 pounds.[12] Remembering that Bruges was the export market for Scottish wool, it is not a surprise to find that the Scots were using Brugcs weight for wool exports.

Wool in England was gathered from the rural producers by specialist wool-packers, middle-men acting for the major wool merchants, whose responsibilities included the careful sorting and grading of wool into the price categories recognised by the international market. The sorted wool was compressed into canvas bales in which it was transported and sold, often to be subject to further sorting and weight adjustment at later stages, with each bale being marked with suitable identifiers. The complexity of the operations and economics of this trade is well illustrated in the recent analysis by Alison Hanham of surviving rccords of a family of English staplers or wool merchants active in the export of wool through the English staple at Calais in the late fifteenth century.[13] By this period the actual trading unit was a heavy canvas 'sarpler', normally containing between 2 and 2¾ sacks-weights of wool, but the weight of wool traded was still reckoned in sacks and cloves, and it is convenient to remain thinking in terms of individual standard sacks.

The inference from our interpretation of the *Tractatus* is that the 350 pounds recorded for the woolsack must represent the net weight of wool in the sack, recorded in an inclined-beam weighing of the complete sack. But by the late thirteenth century customs duty was lcvicd by weight on exported English wool, and the weighing was conducted by officials using level beams to demonstrate the accuracy and authority of their assessment. The weighing by the customs officers was almost the last operation before shipment (since warehoused wool lost weight in drying), and therefore the bales were necessarily already packed and sealed: it follows that the

recorded weight was the gross weight and considerations of cloffe and tare indicate that this should be 364 pounds (350 x 1.04 = 364). It was this *official* level-beam weight which was given by Pegolotti when he described the English woolsack as being 52 cloves, each of 7 'English' pounds, making 364 pounds in all [Peg, 254]. In contrast, the net weight of wool indicated by inclined beam was 50 cloves or 350 pounds. English merchants continued to use the inclined beam, but in 1340 the woolsack was formally defined in statute as 364 pounds and inclined-beam weighing for wool (as for other produce in bulk) was progressively eliminated.[14]

Although nothing in Pegolotti's account cautioned that the official weight given for the English woolsack was a gross weight, we can find support for this view in the details published by Alison Hanham, albeit for a period 150 years later. Implicit in the figures she has analyzed for shipment weights recorded by customs officials in the 1480s is a rebate of 2 cloves per sack-weight allowed to the merchant for the canvas covering, so that in practice the customable weight of wool per woolsack was only 50 cloves, or 350 pounds.[15] In line with this is the rebate of 4 cloves per sarpler for the canvas and turn of the scale ('canvas and draught') allowed in sales between the gatherer, packer and stapler.[16]

Pegolotti did not provide a weight for the woolsack in Florence, but it seems that this was also a gross weight. Taking the conventional historical definition of the Florentine sack as 500 *sottile* pounds,[17] weighed on the official steelyard (and therefore broadly equivalent to level-beam weighing), the Florentine pound would be 5,241.6 grains (364 x 7200 ÷ 500), the same figure as derived from Pegolotti's equivalences. It does not matter if some definitions for the woolsack give a gross weight - any price compensations the market considered necessary were readily made.[18] What was important was uniformity in measurement, together in this case with the ability to influence and control the weight of wool measured on the northern beams.

It must be emphasised that there was no change to the mass of the woolsack in moving from an inclined-beam measurement of 350 pounds to a level-beam measurement of 364 pounds, despite fears to the contrary expressed at the time; rather it was the method of weighing that had changed.[19] In fact, two separate features had altered: a cloffe adjustment of 4 parts per hundred had been invoked, represented in the standard characteristics of north European inclined beams; and secondly a tare adjustment of the same size had been made so that the weight was the gross and not the net weight of the goods. It was possibly a reaction to this seemingly double disadvantage that led Spanish wool merchants purchasing at Southampton in 1290 to complain that they were losing half a pound in the clove (or 28 pounds in 350) in their transactions.[20]

From the formal adoption of the 7,000-grain pound as the English statutory 'avoirdupois' pound in the sixteenth century, the woolsack has been recognised as 364 pounds. This does not represent a reduction in the size of the sack - rather, we are seeing a return to a net definition of the sack's contents. The difference between this and the gross sack weight of 364 x 7,200 pounds is about 3 per cent. This is very close to the actual tare value of the canvas recorded in a late fifteenth century English instance as 28 pounds per sarpler (3.4% at an average of 2 to 2¾ sacks to the sarpler, although this also includes a proportion for wastage), but it matches a contemporary Italian statement.[21]

Conclusions

The use of Pegolotti's handbook in conjunction with early English and Scottish metrological documents has shown a number of significant links between the weight systems of several important north European centres in the twelfth to fourteenth centuries.

The commercial pressures of the international market in this region (developed initially by Florentine merchants and financiers) and the trading opportunities opened up by this new market, can be recognised in a number of ways. Weight units are found to be linked in simple mathematical ratios, and units associated with dominant centres are found to have penetrated the metrologies of their trading partners. Bulk trade was conducted in each centre using large weight units (hundredweights and loads) which were characteristic of that centre, rather than of the nature of the goods being traded. There are simple relationships between these bulk units, and some centres used the same units. A particular and important case is the woolsack, which can now be seen to be a stable international unit of constant weight. Goods in bulk were measured by inclined beam (although often divided up and re-sold in smaller quantities by level beam), and the beams of the north European centres were constructed to have the same controlled characteristics.

These features improved the convenience of the market for merchants and simplified the processes of computation - strengthening the feeling that this interpretation is correct. However, a consequence of this more radical approach is the need to make significant modifications to our understanding of English metrology at this period, including changing the weight dependence in the earliest definitions to the Cologne ounce and admitting the use of a wide range of European weight systems in the marketplace.

The fact that these weight systems are intimately related may mean that key aspects were introduced at the start of this period of international trade, perhaps for the convenience of Florentine merchants - indeed this may be the implication of the woolsack matching the early Florentine definition. Although the sack was defined in Florence in terms of *sottile* pounds (of 12 ounces), and necessarily as a level-beam weighing, it is more likely that bulk trade was conducted in *grosso* pounds (of 16 ounces). The woolsack's gross weight is 375 Florentine *grosso* pounds (500 x 12 ÷16), but this is exactly the same number of pounds that was recorded (in the *Tractatus*) for the woolsack weighed by inclined beam in Bruges merchant pounds. This relationship arises purely from a cloffe allowance that depends on standard characteristics for the north European beams and from the application of an equal tare allowance. In its simplest form, the cloffe allowance links the Bruges and Florentine pounds directly through inclined-beam measurement. Thus goods weighing 100 *grosso* pounds by level beam, would also weigh 100 Bruges merchant pounds of 6,720 grains by inclined beam (fig. 6). So striking is this relationship, that it is tempting to suggest that it is not coincidental and that the Bruges pound was initially set at this level to facilitate the strategic trade established by the Florentine adventurers.

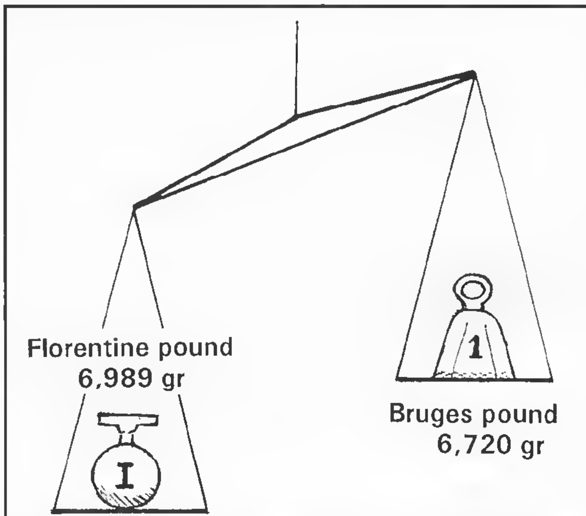


Fig. 6. The relationship between the Florentine *grosso* pound and the Bruges merchant pound by inclined beam.

The geometry of the beams also indicates how inclined-beam weighing in bulk could be related conveniently to re-sale in smaller quantities by level beam. The size of the London and Antwerp spice pounds described by Pegolotti are unusual because they do not have a recognisable ounce basis. However, the pound was a clear factor of the London hundredweight, and it seems to have been restricted to wholesale weighing. The English *Ordinacio* of 1309 required that level-beam should be introduced for spices, and certainly when consignment were broken

up into smaller quantities, they would be weighed by level beam. Because spices were comparatively valuable imported materials, they would be weighed by Paris weight. But as the ratio of the Paris and London spice pounds is 7,560 : 7,269.23, or 104:100, it follows that a consignment of (say) of 100 London or Antwerp spice pounds on the inclined beam, or 104 on the level beam, would break down into 100 Paris pounds, measured for re-sale of the level beam. In this case also, the equivalence simplifies the necessary calculation.

If this postulated metrological link between south and north Europe is correct, it might be expected that a direct equivalence of the Florentine *grosso* pound (of 6,989 grains) would also be found in the northern markets. It is suggested that this may be the origin of the 'avoirdupois' of 7,000 grains, set at a value of less than 0.2% higher than the Florentine weight. Such a small difference would be immaterial for bulk transactions, and it may have been much more important to establish a compromise pound that bore an exact relationship with the Bruges merchant pound. In particular, the pound of 7,000 grains fits the hundredweight of 100 Bruges pounds and the clove of this hundredweight is an exact number of pounds (6 pounds). It also gives a convenient fit for the inclined-beam weight of the woolsack (at 360 pounds) with binary factors (which the *grosso* pound cannot provide), and it forms an exact factor of the Paris and London hundredweight, with a hundred of 108. The nature of this apparent compromise in setting the English statutory level of the 'avoirdupois' pound can be detected in the mid-sixteenth century confusion about the 'true' size of the pound formally introduced by the administration of Elizabeth I.[22]

Although the origins of these weights may be shrouded in the distant past, considerations of the structure of trading metrology can take us very much further back towards these origins than could have been anticipated even a few years ago.

Acknowledgements
See page 1997.

Notes and References

1 Francesco Balducci Pegolotti (ed. Allan Evans), *La Pratica della Mercatura* (Cambridge, Mass., 1936). For simplicity, references to this will be given in square brackets in the text as 'Peg', with the relevant page numbers, and the extracts here are the present authors' translations from Pegolotti's abbreviated Italian.

2 A more extended account will be given by the present authors in their forthcoming volume, *The Weights and Measures of Scotland*, to be published in 1996.

3 *Statutes of the Realm*, 11 vols (London, 1810–1828), I, 204–5, the translation reprinted in R D Connor, *The Weights and Measures of England* (London, 1987), 320.

4 Richardson, H G & Sayles, G O (eds. & trs.), *Fleta, II*, Selden Society, 72 (London, 1955), Ch 12, 119.

5 Translated from Hubert Hall and Frieda J Nicholas, *Select Tracts and Table Books relating to English Weights and Measures (1100–1742)*, Camden Society Miscellany, 15 (London, 1929), 43. Here the editors interpolate 108 pounds for the (apparently incomplete) hundredweight of spices, but a check of the original manuscript (British Library MS Add. 37791 f.9) confirms 104 pounds.

6 [Kingdon, J A], *The Strife of the Scales* (London, 1905), 29–32.

7 Swetz, F J, *Capitalism and Arithmetic: The New Math of the 15th Century, Including the Full Text of the* Treviso Arithmetic *of 1478, Translated by David Eugene Smith* (La Salle, Illinois, 1987), 133–138, 232–234.

8 For ease of comparison with other sources, weights are given in terms of English Troy grains, as in Part I, although it is understood that the English Troy grain was introduced formally into English metrology after the period under discussion.

9 It follows that another earlier suggestion that hundredweights of 100 and 104 increased in weight to 108 and 112 pounds (all of the same type) cannot be maintained either: Connor, *op. cit.* (3), 136.

10 Described in Part I. We are indebted to Gerard Houben for drawing our attention to the survival of these weights: personal communication, 27 April 1993.

11 'Saccus lane debet ponderare xxviij petr, [hoc est CCC & I. li.] Et in aliquibus partibus xxx petr [hoc est CCClxxv. li.] Et idem sunt sedm majorem & minorem libram.' : *Statutes of the Realm*, *op. cit.* (3), I, 204 (from the original in the British Library, MS Liber Horn., f.123).

12 Thomson, T & Innes, C (eds.), *The Acts of the Parliaments of Scotland*, 13 vols (Edinburgh, 1814–1876), I, 673–674.

13 Hanham, Alison, *The Celys and their World: An English Merchant Family of the Fifteenth Century* (Cambridge, 1985).

14 Connor, *op. cit.* (3), 137.

15 Hanham, *op. cit.* (13), 125.

16 *Ibid.*, 118, 119.

17 See, for example, Berriman, A E, *Historical Metrology* (London, 1953), 6.

18 For example, Alison Hanham found no suggestion that tare allowances were made on woolsacks at Calais, and quotes G Schanz, *Englishe Handelspolitik* (Leipzig, 1881), II, no. 130, which states that 'In Calais ... the canvas which is about all the sarpler is sold [as] wool': Hanham, *op. cit.* (13), 127.

19 Stapleton, T (ed.), *Liber de Antiquis Legibus*, Camden Society, 34 (London, 1846), 34.

20 Strachey, J (ed.), *Rotuli Parliamentorum* (London, 1767–77), I, 47.

21 Hanham, *op. cit.* (13), 118; 'The hundredweight of wool ..., tare being 3 per cent' (1478): Swetz, *op. cit.* (7), 136.

22 Connor, *op. cit.* (3), 241–242.

Review

Akan Weights and the Gold Trade by Timothy F Garrard, published by Longman, London, 1980. Price £22.

This book demonstrates how closely the elements of a culture are inter-related. The author's discussion of Akan weights and the gold trade encompasses the history, archaeology, trade, art and social customs, not only of the Akan, but also of the Islamic and European peoples with whom they came in contact. The clear exposition of a complicated subject and the detailed study of many aspects make this a fascinating book for the students of half-a-dozen disciplines.

Mr. Garrard has tried to establish the facts about his subject using many sources, including the Akan oral tradition, and one of his aims has been to correct the fallacics and distortion of emphasis that previous accounts have perpetuated.

Akan peoples, in an area covering central and southern Ghana and the eastern Ivory Coast, were engaged in the gold trade for many centuries, trading with Arab and Berber merchants of North Africa and Egypt from as early as the eighth century A.D. but the trade flourished between 1400-1900 A.D.

The abundance of gold in this region led to the adoption of gold-dust as a currency, so a need for careful weighing led to the development of fine weights. The Akan were practising metal-casting in the late fifteenth century, when Portuguese traders noted their artistic skill in metalwork, woodwork and weaving.

Throughout the centuries, most of the gold-weights were made of brass of varying quality, though a few silver and gold gold-weights have been found or reported, and some have been made of white

metal. The earliest Akan metalwork may have imitated Sudanese weights, beads and jewellery, but from the fifteenth century, their own distinctive forms were developed.

From the eleventh century there was contact and trade with Europe, and gold from Western Sudan was used for much mediaeval gold coinage. Portuguese traders established a foothold in the area with the construction of a fort at Elmira, and one of the most entertaining parts of the book deals with the constant competition from other nations, and also the way the Portuguese tried to limit the freedom of trade for the Akan. Both the traders and the Akan could be unscrupulous when it came to cheating the other side! From their trading during the next 170 years, it is estimated that the Portuguese obtained more than 1½ million ounces of gold.

The gold trade was at its height in the seventeenth century, but about 1700 gold-dust was required internally for currency and the Akan discouraged the movement of gold from their territories to other countries. In the early nineteenth century the gold trade revived, but drew to a close with the decline of the Akan gold-dust currency, and by the end of the nineteenth century, the direct trading of gold between the Akan and Europeans became rapidly obsolete.

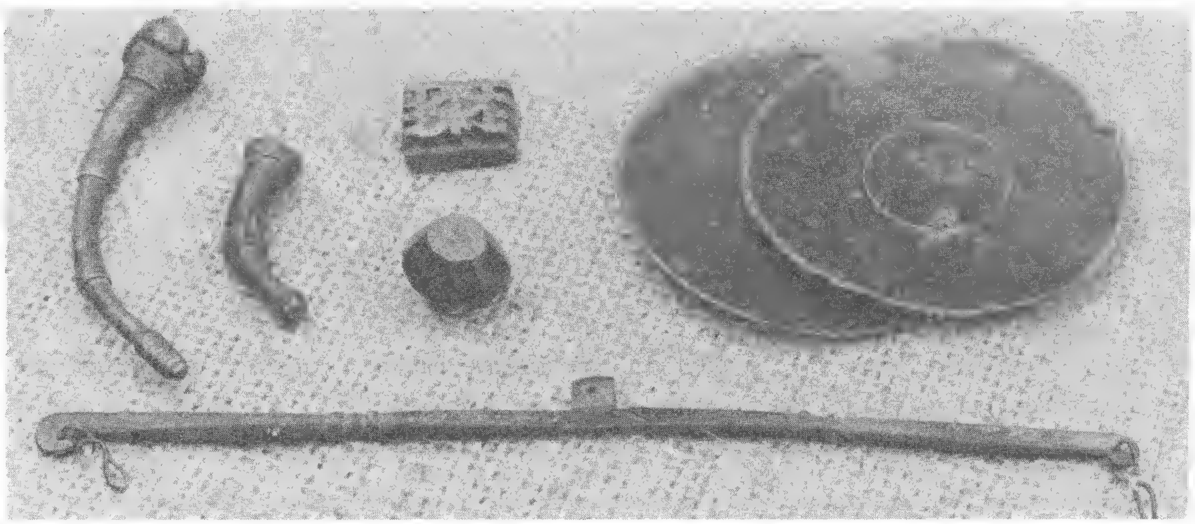


Fig. 1. Akan weights, paper-thin pans & beam missing its central suspension cord. N Sturgess coll.

The gold-weights were cast by the lost wax (cire perdu) method. There is little information available about individual goldsmiths, and it is not possible to attribute any weights to a known goldsmith, as standard designs were often widely copied.

The book discusses methods of gold mining and probable production figures. This chapter includes the frustrated attempts of Europeans to bypass the Akan and mine the gold for themselves. Unfortunately, one dispute led to a trading-post being blown-up by gunpowder, and an early attempt at industrial espionage by an undercover survey (which had to use a secret language for communication) came to nothing.

A gold-dust currency required special scales and spoons, as well as boxes known as *kuduo*, to hold the gold-dust. See EQM p. 569. Often the kuduo showed the same decorative motifs as the gold-weights. It was claimed that some chiefs had all their weighing equipment made of pure gold, including the gold-weights. Oral traditions claim that some traders had bags of several hundred weights to cope with all requirements.

The design of gold-weights can be roughly divided into geometric and figurative, with some designs associated with specific proverbs. For example, the symbol of a drum may signify the proverb, *"If the drum has a head, you do not beat its sides."*

But the significance of the designs of gold-weights is a very confused subject. Various theories have been put forward linking the designs with systems of weights, numerals or writing, but none has been confirmed. The swastika, for instance, has been given at least six explanations!

The Akan weight system as it is known today began to evolve in the fourteenth and fifteenth centuries, and is a combination of Islamic and European Standards, and the book gives a painstaking account of the influence of the various systems of weights on each other, such as the Islamic ounce of 31.5 grams' influencing the various European bullion Standard.

For ordinary trade, the Akan used as many as 39 different units represented by metal weights, all less than 2½ ounces. Accurate weight was essential, and goldsmiths might add lead to achieve correct weight, or ruthlessly remove a limb, tail or horn from beautifully-cast figurative weights if the weight proved too heavy.

Akan weights represent a total of at least 60 distinct units, ranging from 1.4 grams to 1866 grams. Several lists of weight-names have survived, and the discussion of their names is included. The prefix *'anana'*, for example, means 'strange/foreign', and appears in the name of weights of European weight-standards.

The Akan weights are divided into the Early and Late stylistic periods. The Early Period, which ended about 1700, has ten classes of geometric weights and the figurative weights show boldness and simplicity, and often represent aspects of military prowess, such as warriors with shields. The Late Period overlapped the Early Period by about 20 years round about 1700. Its geometric forms are more ornate, and its figurative forms show a proliferation of ornate and complex types covering a very wide range of subjects, and often direct castings were made of small objects such as snails or beetles.

Dating weights beyond classifying them as Early or Late is difficult unless found in an archaeological context or showing external influences, for example, of Dutch and English silverware designs.

It is unlikely that many weights were made after the troubled end of the nineteenth century disrupted old traditions of metal-casting. The use of gold-dust and nuggets as currency was forbidden by the Demonetisation of Gold-dust Ordinance of 1889, and the use of Akan weights was made illegal by the Weights and Measures Ordinance of 1896. The abolition of domestic servitude also reduced the labour available for gold-mining. It was seen as slaves' work, and avoided if possible.

It has been calculated that over the five centuries from 1400-1900 A.D. probably three million weights were made. About two-and-a half million have probably been exported, either during trading or because of the artistic interest they hold for collectors. Groups and hoards have been broken up, and the artistic value of the weights has led to many of them being used as currency themselves.

Twentieth-century fakes are widespread, and there are some superb forgeries, but Akan weights are virtually indestructible unless they are melted down, and an enormous number of genuine weights survive.

It has been said that every branch of trade and industry known to the Akan has been influenced in an extraordinary manner by the adoption of the gold-dust currency. One result was the production of

these gold-weights - an example of the human instinct to add beauty and interest to objects of practical use.

This book is a superb account of the subject. It is difficult to imagine anything better being produced which covers so many aspects. And it is very readable! S HOLROYD

Editor:- Other sources on the subject include:-

1 Garrard, T F, *Akan Goldweights and Gold Trade*, London, Longmans, 1980.
2 Garrard, T F, Studies in Akan Gold Weights, in the *Transactions of the Historical Society of Ghana*, vol XIII-XIV, 1972.
3 Nitecki, André *Equal Measure for Kings and Commoners- Gold Weights of the Akan*, and reviewed in EQM, page 594.
4 Niangoran-Bouah, G, *The Akan World of Gold Weights*, in three volumes of glossy photographs and text in French and English. Volume 1 'Abstract Design Weights' was published in 1984. Volume 2 'Figurative Weights' was published in 1985. This will be reviewed in EQM in the future. Volume 3 will describe the role and function of weights in Akan society.
5 Fagg, William, *Les Merveilles de l'art nigérien*, Paris, 1962. This book only deals with weights in passing, but Fagg has great knowledge of the art of West Africa.
6 Forien de Rochesnard, J & Lugan, J, *Catalogue générale des poids*, Anvers, 1955. Two pages are devoted to Akan weights.
7 Webster Plass, Margaret, *African Miniatures; the Goldweights of the Ashanti*, published in London by Lund Humphries, 1967.
8 Menzell, Brigitte, *Goldgewichte aus Ghana*, Berlin: Museum für Volkekunde, 1968.

Review

Il Museo della Bilancia a Campogalliano edited by Roberta Gibertoni, Annalisa Melodi and Giulia Luppi, published 1995 by Electra, Milano Elmond Editorri Associati.

La Bilancia: un simboli un'arte una storia di uomini, published by Societa Cooperativa Bilancia, Italy.

In 1949 five skilled workers were sacked from the Italian Crotti Scalemaking Company, the result of a bitter strike by the workers' presumably reacting to the reimposition by the Crotti Company of pre-war values into a very different post-war situation.

At that time, the Crotti Company completely dominated the small town of Campogalliano in northern Italy. Unless employed by Crotti, work for scale-makers was very limited indeed. As the sacked workers wished to continue to use their skills, they did the only thing they could do; they started a small scale-making business in the cellar of a house on the southern part of the town. It was a cooperative venture, perhaps one of the first of the many cooperatives that emerged during the 1950s and 60s throughout the western world.

Because of their combined skills, the cooperative venture was able to make high-quality scales and, though facing severe difficulties, succeeded in selling their products to a growing market in Italy and later in Europe. Soon, other skilled workers from Crotti joined the growing cooperative and the venture moved into larger premises. Thus the *'Societa Cooperativa Bilanciai della Campogalliano'* came into being, prospered and became the major scale-making company that it now is.

This story is described in a well-illustrated 1983 booklet - *La Bilancia*- prepared by the coop-erative and which goes into some detail about the history of balances and then of the cooperative itself. In addition, it also has a section on the sculptured artwork commissioned by the society to commemorate the founding members.

The same story of the start of the society is briefly described in a 1995 guide-book to the Museum of Balances in Campogalliano - Il Museo della Bilancia a Campogalliano - which was founded by the cooperative in 1989, and is the only museum of its kind in Italy.

The spirit and dedication of those five original entrepreneurs is continued by the Societa Cooperativa Bilanciai not only through such enterprises as the museum, which, judging by the profuse illustrations in the guide-book, would seem to be a wonderful place to visit, but also through the commissioning of works of art, and the care and attention they expend upon the looks of the factory and its surrounds.

This section of the guide contains a splendid coloured street-map of Campogalliano that identifies for the visitor all the important historical scale-making sites and also all the current company production-plants and research facilities. The map is drawn with clear detail and, at first glance, appears almost mediaeval. However, the autostrada plan slashing across the right-hand edge of the map quickly dispels that image.

The other main sections in the guide are equally informative, and the whole book is (fortunately for the reviewers at least!) presented in parallel Italian and English texts, the English text printed in Italic script for clarity of course! Almost every one of the 87 pages of the guide-book contains at least one, often two or more, illustrations, many in colour and all with bi-lingual captions.

Briefly, the main sections are:-

1. Introduction: being an account of peoples' need to measure and weigh throughout history. The technical evolution of the balance is well described and its cultural influence as a symbol of civilisation is explored.

2. The Visit: being an itinerary through the museum containing clear descriptions, diagrams and illustrations of some of the 450 exhibits from the 13th to the 20th Century.

3. Appendix: being a description of the history of the company and also an account of the museum's educational functions including a comprehensive library, computer network-stations, and the facilities for study (that the museum extends to local educational institutions, with work-space, equipment, and expert supervision.) All this is not unlike the help given to schools and individuals by the museum of the Philips Electrical Co. at Eindhoven in Holland, the sort of service that U.K. company museums might care to emulate. [Avery's provide an excellent service on one day a week.] In 1992 the National Documentation Centre was established within thc museum to stimulate and encourage research into, and knowledge of, 'the balance'.

In summary, the guide-book gives a very readable account of:-

1 Measuring and Weighing as a Daily Need 2 The Balance in the Life of Mankind
3 Mass and its Measurement 4 The National Documentation Centre at the Museum
5 The Itinerary - History of the Town 6 The 'Spheres' of Production
7 European places where important balances may be seen 8 A selected Bibliography

If the guide had an index, then it would be an extremely useful reference text. Unfortunately it is not always easy to track down an item of interest, nor are the various sections and sub-sections clearly distinguished. There are a few errors: a nineteenth century Sovereign balance is described as being twentieth century, for example, but the book will be of use to students of balances everywhere, as well as to visitors to the town of Campogalliano and to the Museo Della Bilancia.

It is a rare pleasure to find a museum guide like this, that is useful, readable and a joy to look at.

P &S HOLROYD

Editor: due to shortage of space, the last part of Verification Marks has been with-held until the next EQM.

ISASC

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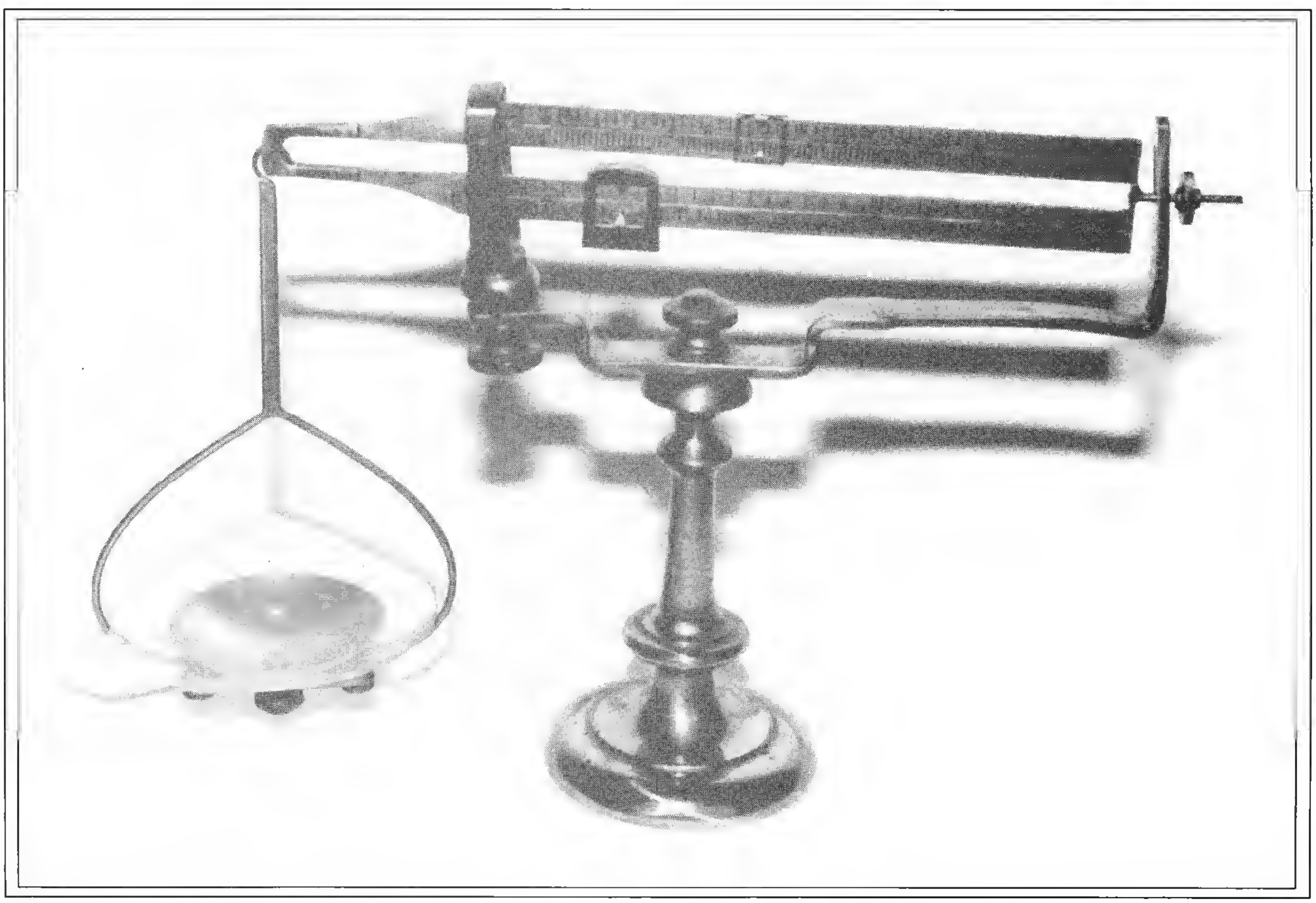

Cover Picture

Prescription Weighing Scale, patented by Calvin H. Fitch in June 12, 1888, shown in patent drawings in Fig. 5, page 2041. See pages 2038 to 2049 for the full story, by Bill Doniger.

This extraordinary scale, which measures only 8½ x 6½ x 3½ inches (214 x 163 x 90 mm) overall, probably represents Dr. Fitch's attempt to provide pharmacists with a prescription compounding scale that was faster to use than an equal-arm beam with weights, and less bulky than the Roberval scale that was in widespread use by American pharmacists in the 1880s.

The steelyard beam is slit along its length, giving the appearance of two beams, one above the other, each graduated to weigh in both apothecary and metric units. A circular glass pan, 3" (75 mm) in diameter and having a pouring lip, is suspended from a bearing at the tip of the blade. One end of the supporting frame is bent upwards to form a carrier (to prevent excessive movement) with an index-screw. This screw has three functions; it can be tightened against the carrier to lock the beam while in transit; it can be adjusted along its length to minutely alter the length of the beam and thus improve its accuracy; it can be read off against a mark on the carrier to ascertain horizontality.

Comparing the reality with the initial ideas as set forth in Patent No. 384,247, it is clear that Fitch simplified or eliminated the more sophisticated parts, such as the spirit level mounted across the supporting frame (Fig. 5 on the patent), the locking mechanism (Fig. 6 on the patent), and the linkage needed by the top-pan. The final product would have been very much cheaper to make, and in some ways more accurate than his initial design.

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Local Verification Marks:

By N BIGGS

The Administrative Background PART FIVE -- the twentieth century

The Edwardian era

The short reign of Edward VII (1901-1910) saw several steps towards uniformity of Weights and Measures administration. In the matter of local verification, a good example of the need for some further rationalisation is provided by comparison of the marks shown in Figures 1 and 2. Figure 1 is the mark used in the Eastern Division of Cornwall in 1903: the line E9R is formed by enclosing the local verification number 9 within the royal cipher ER, and the line 0E3 comprises the district E (Eastern) within the year 03. By contrast, Figure 2 depicts the mark used in the 'Lewes' district of East Sussex in 1904: here the line E4R signifies the year (190)4 within ER, and the bottom line is the district number 215.

Fig. 1: Cornwall (East) 1903

Fig. 2: East Sussex (Lewes) 1904

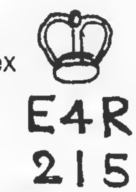


Fig. 3: Salford

Quite apart from such curiosities, there were still a large number of minor variations in the marks used by local authorities in the early 1900s. Some examples are shown in Figures 3-7. Another confusing innovation was the use of code letters and digits to indicate the date and/or the inspector responsible for stamping. These code marks were separate from the main stamp, and were used mainly in the larger County Boroughs, such as Manchester (Figure 8) and Birmingham (Figure 9).

Fig. 4: LCC

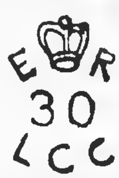


Fig. 5: London

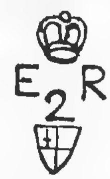


Fig. 6: Smethwick 1901

The Weights and Measures Act of 1904 (4 Edw.7 c.28) sought to provide a central framework for the control of local practices. It explicitly authorised the Board of Trade to issue Regulations concerning matters such as verification and stamping, these Regulations to have the same effect as if they had been incorporated in the Act itself. This device avoided the legal quibbles which had been raised about the Model Regulations of 1890. It allowed the Board of Trade to respond to problems as they arose, without the necessity of enacting new legislation.

Fig. 7: Buckinghamshire

Fig. 8: Manchester

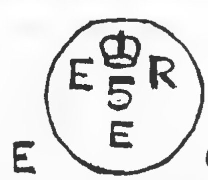
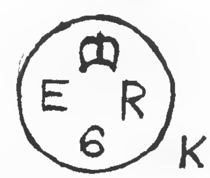


Fig. 9: Birmingham



In due course the Regulations were issued, and they came into force on 1 October 1907. [1] There were a number of further steps towards uniformity. The major change (regulation 60) was that in future all stamps were to be applied to the underside of flat-circular weights, either to a lead plug or (in the case of brass weights) to the weight itself. Before 1907 most verification marks on brass weights were applied to the top surface, although many iron weights were stamped with VR marks on a lead plug on the underside.

Another provision was that date marks were to be obligatory (regulation 20). In the accompanying 'Instructions for Inspectors', it was decreed that the date was not to appear between the letters ER and the number denoting the district. Thus the confusion caused by marks like those in Figures 1 and 2 was ended. The same instruction stated that the system used by each inspector was to be specified in his Annual Report; this was, unfortunately, an open invitation to inspectors to invent their own date codes. Most inspectors used simple and transparent systems, but some used obscure codes. A survey of the systems in use is contained in the *Inspectors Handbook* for 1911, and many of them are explained in Michael Crawforth's article on the subject.[2] Some typical examples are shown in Figures 10-15.

Fig. 10: Yorks WR, 1909

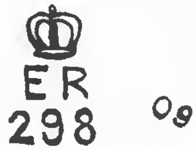


Fig. 11: Rutland (date?)

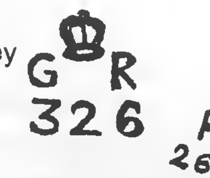
Fig. 12: Colchester July 1915

Another consequence of the 1907 regulations was that the form in which makers' names could appear was strictly regulated, and trade marks were not allowed. Also, the six-pointed star was officially designated as the only approved method of cancelling old marks.

Fig. 13: Essex 1913

Fig. 14: Dewsbury Jan 1925

Fig. 15: Batley June 1926



The persistence of manorial rights

It will be recalled that the Act of 1878 specifically safeguarded the ancient jurisdiction of manorial Courts Leet. As has been mentioned, the rights of the Manor of Wakefield, which had been very active as a W & M authority, were purchased by the West Riding under the terms of the Weights and Measures (Purchase) Act of 1892. At that that time it was said that there remained twenty such jurisdictions, but almost nothing is known about most of them. The only manors to have been issued with numbers were Callington and Calstock, and it is known that they continued to appoint inspectors annually at the Court Leet for a number of years after 1892.

In the case of Callington, from 1901 onwards the Court Leet appointed the person who was then inspector for Cornwall (Eastern Division), but the franchise was not purchased and the right to appoint remained with the Court Leet. In 1909 there was a disagreement with the County Council over a fee, and the Court Leet exercised its power to appoint two unqualified inspectors. One of them was a local grocer and baker, who was thus responsible for checking his own weights. Not surprisingly, this action led to some lively debates, as reported in the *Monthly Review*.[3] At the same time, however, it was reported that the Lord of the Manor of Calstock had agreed to hand over his interests to the County Council.

Thus there is evidence that some manorial jurisdictions persisted well into the twentieth century. As late as 1922 the inspector for Staffordshire (South) was stated specifically to be also the inspector for the Manor of Tutbury, an ancient manor which had acquired standards in 1836. In general the fate of the manorial jurisdictions is matter for further research.

The years of stability

The 1907 regulations finally put Weights and Measures inspection on a sound and stable basis. Of course, the uniform system, together with the practice of stamping on the underside of the weight, meant that local verification marks became rather less interesting. Nevertheless during

the reign of George V (1911-1936) there were some points of interest, as well as a number of developments which had much wider significance.

One noteworthy point was the establishment of a number of new Weights and Measures authorities. Almost all of these were County Boroughs. Between 1889 and 1927, twenty-two new County Boroughs were established in England (Table 8). Many of them had been functioning as Weights and Measures authorities by virtue of their status as Municipal Boroughs, and they had already been issued with numbers. However that was not always the case: for example Southend did not function until it became a County Borough in 1914, when it was issued with the number 547, previously used by Carmarthen.

Table 8

New County Boroughs 1889–1927			
Barnsley 539	Dewsbury 592	Rotherham 467	Wakefield 590
Blackpool 553	Doncaster 439	Smethwick 370*	Wallasey 540
Bournemouth 582	Eastbourne 218*	Southend 547*	Warrington 277
Burton-on-Trent 379	East Ham 480	Southport 281	West Hartlepool 597
Carlisle 392	Grimsby 532	Stoke-on-Trent 485*	
Darlington 148	Oxford 120	Tynemouth 244	

Notes:
1. The numbers marked with an asterisk had previously been used by another local authority.
2. The CB of Stoke-on-Trent was formed in 1910 by amalgamating the former CB of Hanley with the Municipal Boroughs of Burslem and Stoke-on-Trent.
3. The CB of Plymouth absorbed the CB of Devonport in 1914.

Many new Municipal Boroughs were established in the twentieth century, but in general they were not allowed to become Weights and Measures authorities. Probably the last to be sanctioned was Hyde in Cheshire which was issued with the number 598 between 1901 and 1911.

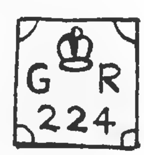
The highly desirable uniformity in W & M practice was, rather unnecessarily, reflected in the drab uniformity of verification marks used at this time. What is more, a high proportion of weights from the first half of the twentieth century carry one of the numbers 33, 65, 270, 370-374, the numbers for North Staffordshire, Wolverhampton, West Bromwich, and Smethwick respectively. This is because several of the large manufacturers sold weights already stamped, the work being done by the inspectors in whose district the factory lay.

Fig. 16: London 1928

Fig. 17: Exeter 1921

Fig 18: Wolverhampton

Fig. 19: Kidderminster



Despite the general trend towards uniformity, there were a few picturesque features. The City of London continued to use its badge, the quartered shield with a sword, together with its official number (Figure 16), and the City of Exeter persisted in its refusal to use any number at all, preferring the traditional EXON (Figure 17). There were also a few ornate versions of the standard mark (Figures 18-19).

The 1920s saw the beginning of a gradual decline in the use of 'loose' weights, as shopkeepers changed over to the use of self-indicating scales which required no weights. Another development of

great long-term significance was an Act of 1926, which, for the first time, made it an offence to give short weight in the sale of food. This was the first step in the evolution of a new role for W & M inspectors, although it was to be another forty years before the transition was complete.[4]

The 1940s and 1950s

The Second World War had few repercussions on the W & M scene. Food rationing required strict control of bread and other commodities,[5] and the inspectors were kept busy at their traditional tasks. One curious event was that in 1943 the Council of the Isles of Scilly was entrusted with several municipal functions, including that of a Weights and Measures authority. In practice, Scilly continued to make use of occasional visits from the county inspector for Cornwall for W & M purposes, and it never had its own verification mark.

After the end of the war it became clear that a major review of legislation and practice relating to weights and measures was due, and a Committee was set up under the Chairmanship of Sir Edward Hodgson. The Report of the Hodgson Committee,[6] published in 1951, drew attention to the trend towards a broader role for W & M inspectors, going beyond than mechanical procedures for the verification of scales, weights and measures. Clearly, the days of the one-man operation were numbered, and there were arguments for concentrating the W & M function in larger units. The Report recommended that the number of W & M authorities in England be reduced from about 180 to about 130. This would be done by disqualifying all the non-county boroughs, with four special exceptions. The Report also recommended a complete revision of the existing legislation, and progress towards metrication. Unfortunately there are no votes in W & M legislation, and the Hodgson Report, like others before it, did not provoke an immediate response from the Government.

The accession of Queen Elizabeth II in 1952 necessitated a change in the uniform verification mark, and the new royal cipher took the form E II R. Some examples are shown in Figures 20-22. Another feature was the issue of many more new numbers. In the first half of the twentieth century only about thirty new numbers had been issued, and the highest number in use in 1950 was 637. But during 1950s it became necessary to begin issuing more numbers, because of the increased number of inspectors. For example, Essex received number 784 in 1953, number 852 in 1959, and number 905 in 1963.

Fig. 20:Hastings

Fig. 21:City of London

Fig. 22:LCC

The Weights and Measures Act of 1963 and its aftermath

Eventually the Hodgson Report bore fruit, in the form of the Weights and Measures Act of 1963, which completely replaced the Act of 1878 and the subsequent Acts. The Act did not follow the recommendation of the Hodgson Report that all non-county boroughs (with four exceptions) should be disqualified as Weights and Measures Authorities, although it did seek to exclude some of the smaller units. Boroughs which had a population of less than 60,000 would cease to be WMAs unless they could convince the Board of Trade that there were good reasons for them to continue.

A number of non-county boroughs did not appeal against this ruling and were thus disqualified in 1965 or before. They included Berwick, Bury St Edmunds, Clitheroe, Congleton, Grantham, King's Lynn, Louth, Newbury, Ossett, Penzance, Wenlock, and Windsor, several of which had

already surrendered their authority to the county in practice. Four non-county boroughs appealed unsuccessfully (Banbury, Batley, Gravesend, and Salisbury) while ten were successful: Crewe, Guildford, High Wycombe, Kidderminster, Lancaster, Reigate, St Albans, Shrewsbury, Stafford, and Winchester. In the case of the remaining small non-county boroughs no decision was ever made; it was deferred from year to year until eventually it was overtaken by a subsequent reform. Thus, for the time being, the following non-county boroughs with populations of less than 60,000 continued to be WMAs: Accrington, Ashton-under-Lyne, Boston, Dover, Folkestone, Glossop, Hartlepool, Hereford, Hyde, Macclesfield, Margate, Morley, Newark, Rochester, Scarborough, Stalybridge, Tunbridge Wells, and Weymouth.

Regarding non-county boroughs which had a population in excess of sixty thousand, the Act provided that if they were already WMAs they could continue to act as such. Those that were not already WMAs could apply to be recognised, and for the first time, Urban District Councils could also apply. Under these provisions several boroughs and urban districts became WMAs for the first time. They were the boroughs of Cheltenham, Epsom and Ewell, Scunthorpe, Slough, Swindon, and Worthing, and the urban districts of Basildon, Havant and Waterloo, Huyton-with Roby, Thurrock, and Woking. Two new authorities with populations under 60,000 were also recognised, the Borough of Crosby in Lancashire, and the Urban District of Crawley in Sussex.

The 1963 Act also heralded the demise of the royal cipher in verification marks, a feature which had persisted since the time of Henry VII (c.1495) at least. A Statutory Order dated 22 November 1963,[7] decreed that the uniform mark was to consist only of the imperial crown and the district number, with a date, as in Figure 23. However, the new form of mark did not become compulsory until 1 February 1969.

Fig. 23: examples of the new uniform mark

Despite all these changes, some traditional weight-stamping activities were still carried on: for example, the practice of inspectors touring their district and setting up 'stamping stations' continued. The article by John Knights in *Equilibrium*[8] contains a fascinating contemporary account of this procedure.

However, yet more sweeping changes were about to come. For many years the work of W & M inspectors had been gradually becoming more concerned with consumer protection, rather than routine verification. The Trade Descriptions Act of 1968 speeded up the process dramatically. It opened up a vast new area of responsibility for the inspectorate, and officers had to learn to deal with a range of complaints from shoppers, dealing with such matters as defective second-hand cars and unfinished holiday hotels. Finally, the Local Government Act of 1972 resulted in a sweeping reduction in the number of W & M authorities. On the formation of the Greater London Council in 1965 the thirty-two new London Boroughs had acquired this function, and they were allowed to continue, together with the City of London. (Most of the London Boroughs became part of consortia for W & M purposes.) But outside London, the only units which survived as W & M authorities were the thirty-nine shire counties and the six metropolitan counties. County Boroughs disappeared altogether. Although some of the new district councils which replaced them applied for agency agreements relating to consumer protection, only one such arrangement proved viable over a long period: that involving Southend and the county of Essex.

Consequently, on 1 April 1974, when the 1972 Act came into force, there were only eighty-eight Weights and Measures authorities in England. By that time, most of them had decided that their W & M Office should become a Trading Standards Department. Twenty years later the Trading

Standing Officers (TSOs) continue to stamp weights, but the vast majority of their time is now occupied by other tasks. All things considered, this seems a good place to end!

Conclusion -- the wider context

The study of verification marks used from 1795 to 1974 is a fascinating subject in its own right. But it is also a permanent historical record reflecting the evolution of ideas about the function of government and the law in relation to the everyday business of buying and selling.

For centuries it has been accepted that the simple rule of *caveat emptor* (let the buyer beware) is not enough to ensure that commercial transactions are fair. In general, the buyer is in no position to check that a pound weight is a true pound. He can however be helped by marking the weight so that the fact that it is a true pound can be recognised. In this way there is formed an alliance between the authority which marks the weight and the buyer who checks that it is properly marked. This principle has now been extended to cover many other situations, such as the labelling of foodstuffs so that the buyer can know what they contain.

In the 19th century the task of ensuring that all weights were properly marked was usually regarded as a policing function, although even then the police were seen as a means of preventing crime, as well as detecting it. The introduction of qualified inspectors continued the move towards prevention rather than prosecution: because inspectors were clearly able to detect irregularities, it became rare for traders to break the law intentionally. The qualified inspectors saw themselves partly as advisers, who helped traders to carry on their business lawfully. The concept of self-regulation, which evolved from that relationship, has become a firmly-established principle of government. However, the range of activities which are now supervised by TSOs means that intentional law-breaking is once again a major problem for them. The situation was highlighted by Cranston's pioneering study [9] of the work of TSOs, carried out in the late 1970s.

The continuing impact of new legislation is another problem. Governments nowadays tend to view the work of TSOs as part of their programme of popular legislation. In the 1970s it was thought, somewhat simplistically, that by investigating price-increases the TSOs could help to control inflation. Subsequently, they were supposed to enhance the efficiency of industry by promoting 'consumerism' -- encouraging people to complain about faulty goods. Unfortunately consumers often expect too much from this process, which leads to a massively inefficient machinery for investigating trivial or frivolous complaints, and detracts from the serious business of suppressing criminal activity.

The problem of interpreting and implementing new legislation, especially that which emanates from the European Community is a difficult one for the TSOs, and is currently the subject of serious investigation. [10] But the problem is not entirely new. The Weights and Measures Acts of 1835, 1878, and 1889 all led to substantial difficulties in their time. The solution then, as it must be now, was to establish a system whose simplicity transcends the complexity of the bureaucratic and legalistic approach.

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This completes Norman Biggs' series on verification marks.

Showcase

A bronze weight, originally stamped crowned A (Queen Anne, reigned 1702–1714), dagger (of the City of London) and A (avoirdupois) round one quarter, with the ewer (Founders' Co. mark) opposing them.

The weight was used through the eighteenth century, and stamped by an inspector for the Borough of Ipswich during the nineteenth century, still being of good weight. Collection J Visser.

Three brass weights with cast letters 'IMPERIAL STANDARD' and 'DIXON & VARDY' and crowned 1 (lb), o8z, and $^{o}4^{z}$. These handsome weights have been viciously stamped on several occasions by an inspector No. 5, and less heavily, crowned ER, a small crowned N and a large crowned N. Collection J Visser.

Dr. C H Fitch, Ingenious Inventor

By W DONIGER in collaboration with R H WILLARD

About thirty years ago in my early scale-collecting days, I purchased a curious small folding scale that is simple, accurate and very well-made. The lid of the small nickel-plated box ($2\frac{7}{8}$ x $1\frac{1}{2}$ x $\frac{3}{4}$", that is, 71 x 38 x 19 mm) bears the inscription

DR C H FITCH'S
PRESCRIPTION SCALE
PAT'D SEPT 29 1885
MANUF'd BY N V RANDOLPH & CO
RICHMOND VA

It is a portable medical scale, small enough to fit into a man's pocket. A folding spatula to dispense the drugs is tucked into the box. Later, I found that the scale was also marketed in a box without the manufacturer's name (Fig. 1). Such a device would have great value to a doctor who was dispensing medicine to his patients in remote areas far from a pharmacy, and may also have been used by care-givers as well as by the general public.

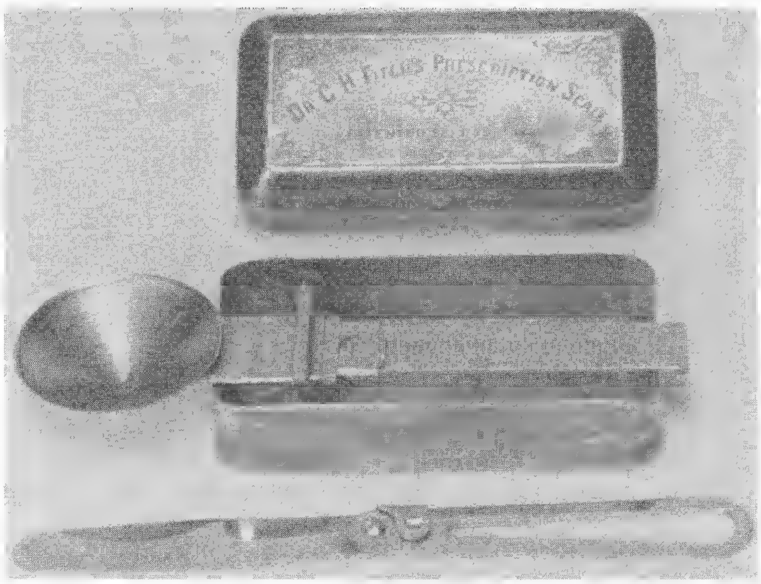


Fig. 1. Dr. Fitch's 1885 Prescription Scale assembled for use. The bearings are mounted in a U-shaped plate that fits under a spring-clip in the bottom of the box, which itself forms a base for the scale. Some boxes show the patent date, September 25, 1885, but omit the name of the manufacturer. Does any reader know whether this indicates an earlier or later version?

Photo G A Wehman

The scale had been packed in a cardboard box covered with "silver" [aluminium] paper. My box is incomplete, but the top label gives the additional information including "*CAPACITY ½ TO 20 GRAINS....PRICE, $1*" and the instruction: "*Be particular to push the SCALE BAR up in the socket as far as it will go.*" (Fig. 2).

After some inquiries I found my way to the nearest U.S. Patent and Trademark Depository Library. Having only the patent date to go by, I had to scan through several hundred microfiche records before

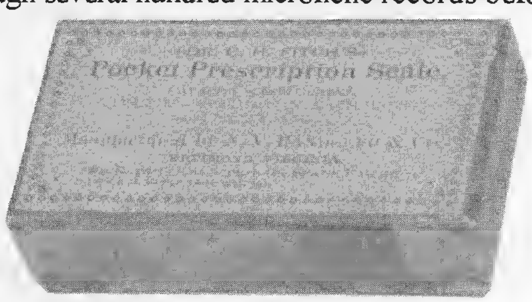


Fig. 2. Paper box for the 1885 scale. Labels inside the packing carton describe the Randolph Paper Box Co. as '*Manufacturers of all styles Druggist Powder Boxes, / Labeled Prescription Pills and Powder Boxes a Speciality. / N. V. Randolph & Co. Propr's. / Illustrated Catalogue on Application*', and warn that '*Care must be taken to put substances to be weighed in center of pan*'.

Photo B Wright.

finding the one I needed. For a small fee I obtained a copy. Patent No. 327,152 was issued on the basis of drawings and specifications, and no model was supplied. Calvin H Fitch, a resident of Middletown Springs, Vermont, assigned a half interest in the patent to a relative, Byron Fitch of Richmond, Virginia. He briefly described his invention as follows: *I employ a casing or box in which the pan and socket piece are fixed to a fulcrum-pin or shaft permanently hung in such casing and adapted to be turned from such box for use, said pan having facilities for readily receiving a detachable graduated arm and movable weight thereon constituting the beam and shaped to preserve the balance, and also permit the ready discharge of its contents, the box forming a base or pedestal for the scales, and being provided with a suitable cover.* (Fig. 4). The full specification is amazingly easy to understand, being taken in logical stages, and using normal, not engineering, vocabulary.

Fig. 3. Dr. Fitch's 1885 scale folded into its box for portability. The conical pan facilitates centering the load for accuracy. The manufacturer's name and address are stamped on the box lid. Dimensions 2.8 x 1.5 inches (72 x 37 mm.) The brass pan was spun into a cone and soldered onto a pointed piece of sheet brass. The beam part of that sheet brass was folded over at its edges to form a channel into which the rest of the beam is slotted when the pan is flipped over. The ⊔-shaped band, with holes for the fulcrum, was held in by a sheet of metal. This sheet was cunningly shaped with slits each side, to be held in the box by its springiness until it was welded into position. The whole scale was nickel-plated after manufacture. The scale is a superb example of how to construct a 3-dimensional object out of flat sheet metal.
Photo G A Wehman.

After some research I found that Dr. Fitch was born in 1830 in New York and was, indeed, a medical doctor. The 1880 federal census shows that his wife was born in Vermont; children were born in New York in 1868 and 1871, and in Illinois in 1876. By the time he applied for the patent in January 1885, the family had settled in Vermont, perhaps to be nearer relatives.

It didn't take long to observe that inventions do not duplicate their patent drawings in every respect. The pan in my 1885 Dr. Fitch scale and on others seen is a shallow cone. The pan shown in the drawings is a V-shaped trough, open at both ends. In his application Dr. Fitch stated that the scale-pan might be "*round, flat, or any shape used for making scales; but I prefer to make it V-shape in cross-section, so as to preserve the 'balance' of the scales, and obviate the necessity for adjustment and, furthermore, to facilitate the emptying of the pan of its contents*". He made provision for various ways of installing the fulcrum pin in its bearings and specified that while the case should preferably be of metal, it might be constructed of wood, paper, or other suitable material. (Fig. 4).

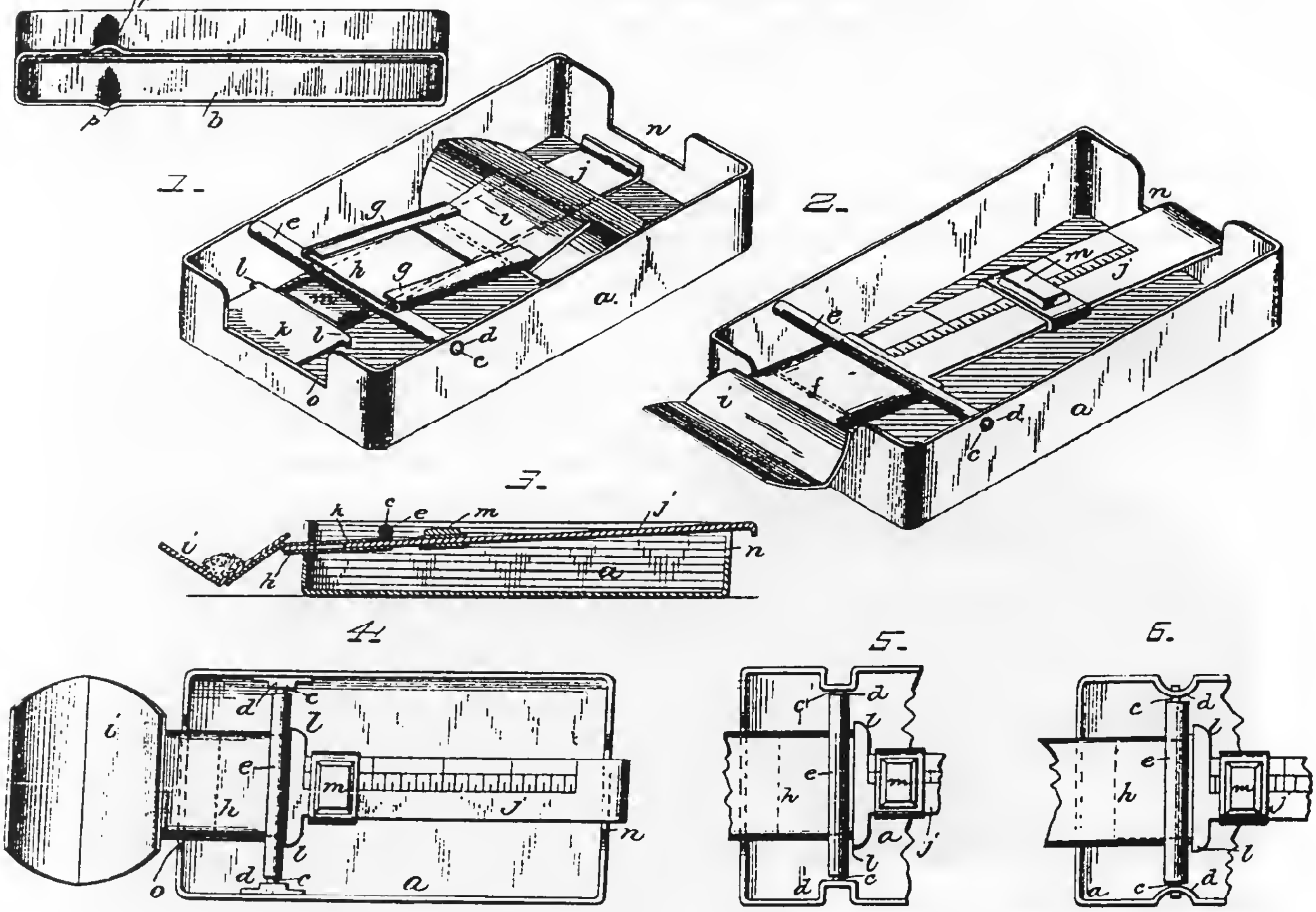
Fig. 4. Patent No. 327, 152, application filed January 19, 1885, patent granted September 29, 1885. ⇨
In his application, Dr. Fitch proposed mounting the bearings in the sides of the box itself and forming the pan like a trough, V-shaped in cross-section for automatic centring of the contents, and open at the ends for ease in emptying.

(No Model.)

C. H. FITCH.

PRESCRIPTION SCALE.

No. 327,152. Patented Sept. 29, 1885.



WITNESSES

F. L. Ourand

Geo. W. Finckel

INVENTOR:

Calvin H. Fitch

by Wm. H. Finckel

his Attorney.

CALVIN H. FITCH, OF MIDDLETOWN SPRINGS, VERMONT, ASSIGNOR OF ONE-HALF TO BYRON S. FITCH, OF RICHMOND, VIRGINIA.

To all whom it may concern:

Be it known that I, CALVIN H. FITCH, a citizen of the United States, residing at Middletown Springs, in the county of Rutland and State of Vermont, have invented certain new and useful Improvements in Prescription-Scales, of which the following is a full, clear, and exact description.

The object of this invention is to provide portable balances or scales that may be carried in a person's pocket for the use of physicians and others, and for families for weighing small quantities of medicine or small divisions of other articles or substances. In order to secure accuracy, that quality so indispensable, particularly in medicine, I deem it essential that the balances shall be of as few parts as possible, and that a permanent pivot be provided for such balances. In order to get the scales within a compass compatible with easy portability some portions must be capable of disjointing, and I find that the member that may be so detached with a minimum loss, and, in fact, no detriment to accuracy, is the graduated arm and weight; hence in constructing my scales I employ a casing or box in which the pan and socket-piece are fixed to a fulcral pin or shaft permanently hung in said casing, and adapted to be turned out from such box for use, and to be reversed into the box when not in use, said pan having facilities for readily receiving a detachable graduated arm and movable weight thereon constituting the beam, and shaped to preserve the balance, and also permit the ready discharge of its contents, the box forming a base or pedestal for the scales, and being provided with a suitable cover.

In the accompanying drawings, illustrating my invention, in the several figures of which like parts are similarly designated, Figure 1 is a perspective view of the scales in place in the box, the cover being shown to the left. Fig. 2 is a perspective view of the scales ready for use. Fig. 3 is a vertical longitudinal section of the same; Fig. 4, a top plan view with a modification in the bearings for the fulcral pin, and Figs. 5 and 6 plan views of other modifications of the bearings, the scale of the drawings being somewhat enlarged over the actual size.

The box or casing *a* is made preferably of metal, and rectangular or oblong in shape, struck up in dies or otherwise formed, and its cover *b* is similarly formed and readily detachable; or said box and its cover may be constructed of wood, paper, or other suitable

material. *c* is the fulcral pin or shaft, preferably made of steel wire drawn with a knife-edge, as shown, and having its bearings in holes *d* in opposite vertical sides of the box, near one end of such box. This pin may be made from a solid piece of steel or other suitable metal with knife-edge shouldered journals at each end, (see Fig. 5,) obtained by reducing the size of the pin or shaft at its ends; but, preferably, as more economical and to secure a more perfect bearing, the pin is passed through a tube, *e*, and said tube is equal in length to the distance between the sides of the box within the box, while the pin *c* is as much longer as is the outside width of the box greater than its inside, or a little more than that, so as to insure permanence of the pin in its bearings, and prevention of so much longitudinal movement as would permit the accidental disengagement of the pin and its bearings.

To the tube *e* (or to the pin *c*, if the shaft is used without the tube,) is secured a strip of metal, *f*, the longitudinal edges *g* of which are turned down, and then toward each other parallel with the piece *f*, to form a socket or sockets, *h*; and to the free end of said socket-piece *f* is affixed the scale-pan *i*, which may be round, flat, or any shape used for scales; but I prefer to make it V shape in cross-section, so as to preserve the "balance" of the scales, and obviate the necessity for adjustment, and, furthermore, to facilitate the emptying of the pan of its contents.

The pan and its socket-piece may be made of one piece of sheet metal stamped to shape, or cut and shaped in dies, or it may be formed of two pieces suitably united, as by solder.

Instead of having the bearings for the fulcral pin in the sides of the box, they may be separate pieces, something like sheet-metal-pail bail ears secured to the sides within the box, as indicated in Fig. 4, or the sides of the box may be indented, as in Figs. 5 and 6, either angularly or in an arc of a circle to form such bearings.

The scale beam and pan may be made of one solid piece, or the scale beam and pan may be made of separate pieces, and these soldered or fastened together in any other suitable manner, and the pan and scale-beam may be so adjusted as to work all within the box; but, preferably, the scale-beam or graduated arm *j* has a tenon, *k*, to fit the socket *h* of the socket-piece of the pan, and it is limited in its inner movement in said socket, and truly registered therein by lateral lugs *l*. This scale-beam is about the length of the box inside. It is provided with a suitable counterpoise or weight, *m*, sliding thereon by the provision of a loop on its under side embracing the said beam, as indicated in Figs. 1, 2, and 3.

The vertical end walls of the box are cut out at *n* and *o* to permit the movement of the scales when put together for use.

When the pan is reversed, or turned into the box, as in Fig. 1, the knife-edge is reversed with it, and consequently it is saved the wear upon it, which is more injurious in disuse ordinarily than when in use.

When the parts are connected, as in Fig. 2, the box forms a base or pedestal for the scales, and they are in this position ready for use.

The openings *n* and *o*, while permitting free play of the scales, preclude all undue lateral motion, and they are usually no deeper than the flange or rim of the cover, so that the cover when in place will completely inclose all openings in the box.

When the bearings for the fulcral pin are in the sides of the box themselves, the cover will be made with recesses *p* to cover them; but these additions to the cover are not necessary when such bearings are used, as shown in Figs. 4, 5, and 6.

The pan may be unloaded by catching up the box and scales together and tipping them sidewise; and inasmuch as the pan from its V shape will compel the load to seek its bottom angle, and thus preserve the balance without deviation and the use of extraneous means to this end, so the load may be readily discharged in a compact mass.

I desire to lay special stress on making the pan a fixture, for thus it obviates any probability of losing said pan and greatly facilitates the manipulation of the device and overcomes the necessity for any adjustment of the pan to balance it.

I propose putting these scales on the market nickel-plated, or in polished brass, or the like, and to supply each with a spatula and a medicine-dropper.

I do not confine this invention simply to a scale for weighing small quantities, but scales may be made on this principle of any capacity, and may be made portable or stationary.

What I claim is—

1. A scale comprising a box having fixed sides provided with bearings, a scale-pan provided with a tube, *e*, and a bearing-pin secured therein, whereby the pan is permanently hung in the said bearings, a scale-beam connected with such pan, and a movable cover for the box to inclose the pan, bearings, and beam within the box, substantially as described.

2. A prescription-scale comprising a covered casing or box having fixed sides, a scale-pan permanently hung in the said fixed sides, and rotatable on its bearings, so as to be capable of being turned into and out of the box, and a scale-beam adapted to be connected with and disconnected from such pan, substantially as described.

3. A box, a scale-pan provided with a socket-piece, and a knife-edge fulcral pin secured in bearings in the sides of said box, and rotatable in said bearings to adapt it to be turned into and out from said box, and a detachable scale-beam provided with a tenon to engage the socket-piece of the pan, combined substantially as described.

4. A box provided with bearings, a fulcral pin rotatable in said bearings, and a scale-pan secured to said pin and adapted to be turned into or out from the box, combined with a detachable scale-beam, substantially as described.

5. A box provided with bearings, a fulcral pin having a knife-edge and rotatable in said bearings, and a scale-pan rigidly affixed to said pin and adapted to be turned out of or into said box to bring the knife-edge of the pin into operative and inoperative positions, respectively, with respect of its bearings, substantially as described.

6. A box provided with side bearings, a fulcral pin having a knife-edge and rotatable in said bearings, a scale-pan and a tube attached to the socket-piece extending from said pan through which the fulcral pin extends to its bearings on either side, substantially as described.

7. The scale-pan made V shape in cross-section combined with a fulcral pin having permanently-fixed bearings, and a scale-beam, whereby the article or substance to be weighed is compelled to a given center, and a true balance thus preserved, substantially as described.

8. The box *a*, provided with openings *n o* in its ends, side bearings, and a cover combined with the pan, its socket-piece, fulcral pin, and detachable tenoned scale-beam and weight thereon, substantially as described.

9. The combination, with the socketed scale-pan, of the tenoned scale-beam having stop-lugs *l* co-operating with the said socketed pan to insure the correct position of the beam in the socketed pan, substantially as described.

In testimony whereof I have hereunto set my hand this 17th day of January, A. D. 1885.

CALVIN H. FITCH.

Witnesses:
BYRON S. FITCH,
H. SWINEFORD.

Within three years Dr. Fitch had designed and patented a second medical scale, but as it happened, it was five or six times that long before I found one. About twelve years ago I acquired a very unusual scale from a friend in New York. The 'knock-down' steelyard came without a box, and the only identifying mark was the patent date, June 12, 1888, stamped on the beam. It looked nothing like the earlier scale, (even though both are steelyards), and is much larger, so I had no idea who invented it until I researched the date. I was delighted to learn the Prescription Weighing Scale Patent No. 384,247 was issued to Calvin H Fitch, who was living in Poultney, Vermont, at that time. This patent, like his first, was issued on the basis of drawings and specifications, and no model was supplied (Fig. 5).

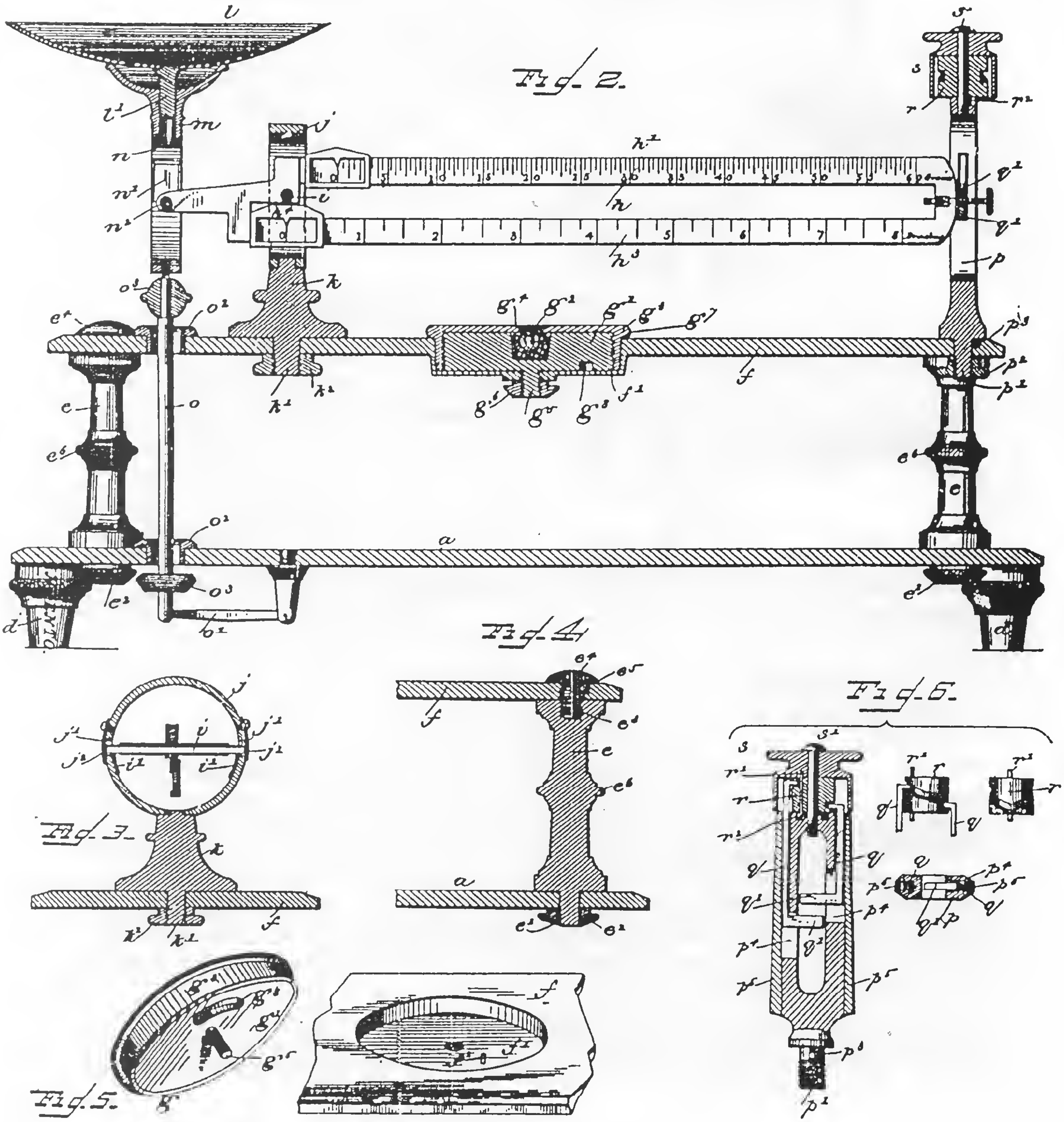
Fig. 5. Patent No. 384,247; application filed July 15, 1887, patent granted June 12, 1888. ⇨
Intended for compounding prescriptions in the pharmacy, rather than dispensing single doses, this scale has 27 times the capacity of the 1885 pocket scale. The scale was originally designed to weigh only in the apothecary system: from

½ to 60 grains (1 drachm) on the upper beam and from ¼ to 8 drachms (1 ounce) on the lower. Note the plan to use a roberval linkage to keep the pan above the beam. Note also the plan to incorporate a circular drum (g) which contains a spirit-level, a nice refinement. Has any reader seen a scale constructed like this drawing? Compare with the manufactured version on the front cover.

C. H. FITCH.

PRESCRIPTION WEIGHING SCALE.

No. 384,247. Patented June 12, 1888.



To all whom it may concern:

Be it known that I, CALVIN H. FITCH, a citizen of the United States, residing at Poultney, in the county of Rutland and State of Vermont, have invented certain new and useful Improvements in Prescription Scales, of which the following is a full, clear, and exact description.

The object of this invention is to provide an accurate, compact, and attractive prescription-scale for druggists, in which small quantities may be accurately weighed without the use of detached weights.

Another object is to so construct the scale, as upon the "knockdown" principle, that it may be disassembled and its parts packed in small compass for transportation, and the scales thereafter accurately set up or assembled for use; and still another object is to provide means for leveling the scales.

With these objects in view the invention consists in the details of construction and in certain combinations, as hereinafter more particularly set forth and claimed.

In the accompanying drawings, in the several figures of which like parts are similarly designated, Figure 1 is a side elevation; Fig. 2, a vertical section with the beam in elevation. Fig. 3 is a section in the plane of line yy of Fig. 1. Fig. 4 is a vertical section through one of the posts. Fig. 5 is a perspective view of the spirit-level, and Fig. 6 shows in section an elevation of details of the beam-locking device.

The foundation or base plate a may be a piece of brass or other metal shaped in dies or otherwise, and provided at its four corners with bosses b and screws c, which bosses and screws receive legs or feet d, having milled collars, whereby the said legs may be adjusted toward and from the said base-plate to level the said base-plate with respect to the surface upon which it is placed, the bosses b fitting within recesses in the upper ends of the legs, so that the legs may have a positive bearing upon the said bosses at all ordinary adjustments thereof with relation to the base-plate, and thereby insure a steadiness of the legs. Four posts, e, are supported upon the four corners of the upper surface of the base-plate a, and these posts receive and support the upper bearing-plate, f, which latter may also be formed in substantially the same manner and of the same material as the base-plate. Referring to Fig. 4, these several posts e have at their lower ends a screw, e', projecting through the base-plate and engaged on the under side of the said base plate by a nut, e^2, and at their upper ends are provided with screw-threaded sockets e^3, which engage screws e^4, the heads whereof rest upon the upper bearing-plate, f, and are prevented from rotating by pins e^5 engaging holes in the upper surface of said bearing plate. The posts are provided with milled collars e^6. The screws e' and the screw-sockets e^3 may be rights and lefts, so that when the posts are rotated they will disengage themselves from both the nuts e^2 and the screws e^4 to permit the separation of the plates a and f.

The plate f is provided with a pocket, f', in which is arranged a circular rotating spirit-level, g. The construction of this level is shown in detail in Figs. 2 and 5.

g' is a block of metal or other material screw-threaded externally and provided interiorly, and substantially in the line of its diameter, with an ordinary level or bubble tube, g^2. This block g' receives a screw-threaded cap, g^3, in which is a leveling sight, g^4. The block g' is provided with a screw, g^5, which projects through the pocket f', and is engaged by a nut, g^6, whereby the said level may be rotated within its pocket to ascertain both the transverse and longitudinal horizontality of the scales. The upper edge, g^7, of the cap g^3 may be milled to provide a hand-grasp for rotating the level. The rotation of the level may be limited to bringing the bubble-tube into two positions, which are at right angles to each other, and for this purpose the under side of the block g' may be provided with a groove, g^8, into which a stop pin, f^2, in the pocket f' may be projected.

It will be observed that scales provided with these leveling-feet and with the spirit-level may be always set perfectly true, no matter how irregular the counter may be upon which they are placed. And this is a very important feature, in that by it the beam will always be preserved in a true position, and there will be no binding of its knife-edges in their bearings, nor will there be any friction of the beam itself against any portion of the frame in which it is hung. The beam h in the instance herein shown consists of an upper member, h', graduated to grains and half-grains, and provided with a permanently-attached counterpoise, h^2, adapted to be slid along the beam, and a second member, h^3, graduated into drams and quarters, and having its zero-point in vertical alignment with the knife-edges of the beam. This member h^3 is also provided with a sliding permanently-attached counterpoise, h^4. By arranging the zero-point of the lower member of the beam immediately under the knife-edges of the beam I am enabled to secure absolute accuracy in weighing with a beam having two scales and supporting members, and still having these two members of the beam practically one beam.

It will be observed that the two members h' and h^3 of the beam are rigidly connected at both ends.

The knife-edge i of the beam is supported upon steel plates i' i' in a circular yoke or bearing, j. (See Fig. 3.) This yoke j is pierced diametrically with openings j' j' opposite the bearings i' i', and these openings are covered by swinging caps j^2 j^2. When it is desired to place the beam in its bearings, one of the caps j^2 is swung aside and the knife-edge i is passed through the opening j' sufficiently to permit the opposite end of the knife-edge to be set in its bearing i' and extended into the opening j', and when so extended and its end comes substantially in contact with the cap j^2 at that end, then the cap of the opposite opening may be swung down and fastened over said opening, thus confining the knife-edge upon its bearings and within the opening, and preventing endwise movement of the knife-edge in its bearings, and at the same time covering up and protecting the said knife-edge.

The yoke j may be made by slitting a tubular piece of metal in rings of the proper width, and thereafter boring the diametrical openings. In this way the bearings for the beam may be very economically manufactured. The yoke j is supported upon the bearing-plate f by a post, k, which post has a downwardly-projecting screw, k', extended through the plate f and engaged by the nut k^2.

The scale-pan l is made with a standard, l', whereby the said pan may be fitted in its socket m; and this socket may be, and preferably is, in order to prevent lodgment of dust, an open-ended tube arranged upon the top of the yoke n, which is constructed with steel bearings n', caps n^2, and diametrically-opposite openings for the reception of the knife-edge n^3 of the scale-beam, to support the scale-pan. The bearing-edges of the knife-edges i and n^3 are reversed, of course, and they are in the same horizontal plane when the scale is *in equilibrio*. The yoke n is connected by the rod o with a steadying-lever, o', pivoted to the under side of the base-plate a in any usual manner, the rod o passing through suitably-bushed openings o^2 o^2 in the plates f and a; and this said rod o may be provided with any suitable counterpoises, o^3 o^3, to balance the beam.

The free end of the beam projects into the slotted post p, secured to the forward end of the plate f by a screw, p', and nut p^2, and held against rotation by a pin, p^3, engaging a hole or socket in the upper surface of the plate f. This post p in the process of its manufacture is provided with slits or kerfs p^4 in the longitudinal side walls of its slot, in which slits or kerfs are arranged oppositely-moving beam-locking devices q, and thereafter these kerfs are practically covered up by inserted strips p^5. These beam-locking devices are engaged by a serpentine cam, r, mounted to rotate upon the top of the post p and provided with a surrounding cover or cap and a rotating device, s, the two being united to the post by a rivet or screw, s'; and the cam r and cap s being united to one another so as to turn together by a pin, r', which also serves the additional purpose of a stop by playing in a semicircular groove, r^2, in the top of the post p. (See Figs. 2 and 6.) It will be observed that as the cam r is rotated the active ends q' q' of the beam-locking device will be caused to approach toward or recede from each other, and their limit of approach is arranged in line with the active edge of the knife-edge i, so as to hold the beam in a true horizontal position. The beam co-operates with these beam-locking devices by means of a screw, t, set in the free end of the beam and passing between opposite edges of the active ends q' of the beam-locking devices. This screw t subserves the additional purpose of a counterpoise or equalizer for the beam, for by adjusting it back and forth in its bearing in the beam the length of the beam, and consequently its weight as a lever, are increased or diminished. The cam r effects the complete movement of the beam-locking devices by about a quarter or nearly half turn, and thus the beam may be very readily and very quickly rendered rigid and immovable. This is a decided advantage in this class of scales where the knife-edges are necessarily fine, and the vibration of the beam, if left unrestrained, wears rapidly upon the knife-edges, and hence destroys the accuracy of the balance.

I desire to call attention to the facilities for disassembling the scale in order to pack it for transportation. The pan l is simply lifted from its socket, when the yoke n and its counterpoises are readily detached. The yoke i, with its post or standard, is readily detached from the plate f. The beam h is readily lifted out of its yoke and disconnected from the post p. The post p, with its appurtenances, is removable bodily from the plate f by removing the nut p^2, and the plates a and f are disconnected by rotation of the posts e.

Scales thus constructed may be arranged within any suitable protecting-case.

What I claim is—

1. A prescription-scale comprising a pan and a beam provided with the permanently-fixed sliding weights, a bearing-plate, a post to which the beam is pivoted and which is detachably connected to the said bearing-plate, a foundation-plate, and removable posts in-

terposed between the foundation-plate and bearing-plate to render the former detachable from the bearing-plate, whereby the parts of the scale may be readily disassembled and the scales "knocked down" for storage and transportation, substantially as described.

2. A foundation-plate provided with leveling-feet, a bearing-plate, aod detachable posts connecting the two plates, and a spirit-level arranged in the upper plate and rotatable therein, so as to be brought lengthwise and crosswise of the plate, to ascertain the level of said plate longitudinally and transversely, combined with a scale-pan, a scale-beam, and bearings therefor arranged upon the bearing-plate, substantially as described.

3. A scale having a rotary spirit-level consisting of a block provided with a bubble-tube, a cap connected with said block by screw-threads, and having a sight for the bubble-tube, and the bearing-plate of the scales having a pocket in which the level is arranged, substantially as described.

4. A scale-beam having two rigidly-connected or integral graduated members, with the zero-point of the lower member in vertical alignment with the knife-edge of the beam, aod provided with permanently-affixed sliding weights, combined with such knife-edge, bearings therefor, and a scale-pan and its counterpoises, substantially as described.

5. The post provided with oppositely-moving beam-locking devices, a cam for moving said devices, and a cap covering the same and adapted to rotate it, substantially as described.

6. A post having longitudinal recesses or kerfs, combined with oppositely-moving beam-locking devices, a serpentine cam engaging said beam locking devices, and means to rotate said cam to grasp and release the beam, substantially as described.

7. A scale-beam having an equalizing device in the form of a screw arranged at its free end, combined with a post and beam-locking devices co-operating with said equalizing device, and means to move said devices toward and from said equalizing device, substantially as described.

In testimony whereof I have hereunto set my hand this 13th day of July, A. D. 1887.

CALVIN H. FITCH.

Witnesses:
MARTIN D. COLE,
A. H. VARNEY.

With this scale the doctor was obviously hoping to extend his market. His objectives, he stated were "*to provide an accurate, compact and attractive prescription scale for druggists, in which small quantities may be accurately weighed without the use of detached weights. Another objective is to construct the scale as upon the 'knock-down' principle, that it may be disassembled and its parts packed in small compass for transportation, and the scales thereafter accurately set up or assembled for use, and still another object is to provide means for levelling the scales*."

At first glance my scale (Cover picture) looks very different from the patent drawings (Fig. 5.) Instead of a rectangular base plate and four corner posts, it rests on a single ornamental pedestal. The pan is below the beam rather than above it. It lacks the prescribed four levelling-feet and spirit-level. But functionally, it is the same. Beautifully designed and durable, it shows the versatility of the inventor. Yet I have never seen another scale like this one (Cover Picture & Fig. 6). I wonder why.

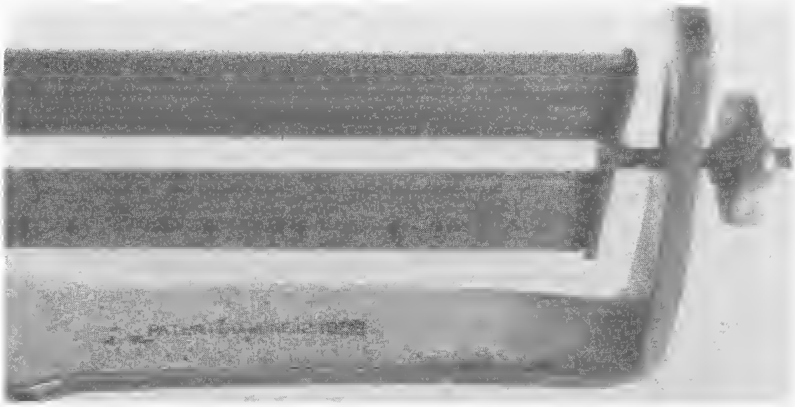


Fig. 6. Detail of double beam showing graduations to weigh 1 to 50 grains or 1 to 30 decigrams on the upper beam and 1 to 8 drachms or 1 to 30 grams on the lower beam. Steelyard beams graduated in two weight-systems are uncommon. Split beams are usually found on large meat or market steelyards, (see EQM p 1593, Fig. 9) and graduated in avoirdupois units. [By dividing the beam a quite unnecessarily large moment of inertia was created in the beam, which caused relatively sluggish oscillations in such a low-capacity balance.]
Photo W Doniger

My third Dr. Fitch scale incorporates several features of the first two. It has the simplicity and portability of the 1885 patent and the gracefulness of the 1888 patent. It is designed as a pocket scale for dispensing individual doses of medication and it has a single horizontal beam. A folding spatula is provided. The scale is supported on a central pedestal, and the detachable pan is suspended below the beam. There is no identification on the scale itself. Its metal box, measuring 3⅜ x ¾ x ¾ ", (86 x 19 x 19 mm) is not part of the scale. The lid bears the legend

THE DR. C. H. FITCH
IMPROVED PRESCRIPTION SCALE
CAPACITY ½ TO 20 GRAINS
PAT. APPL'D FOR

My scale came enclosed in a somewhat oversized paper box giving the patent date Jan. 29, 1895. A selling price of $1.50 is pencilled on the label. The papers for Prescription Weighing Scale

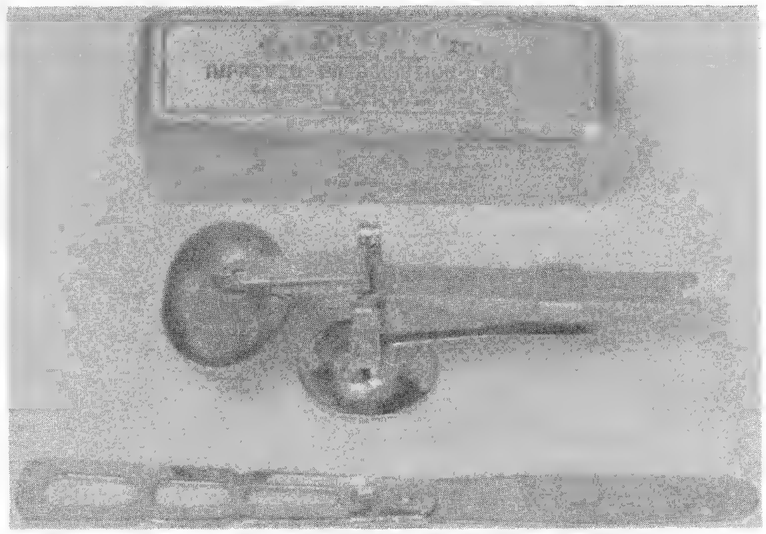


Fig. 7. The Dr. C H Fitch Improved Prescription Scale and spatula assembled and ready for use; unlike the 1885 scale, this one has a carrier to check vibration and its own base separate from the box. The inscription 'PAT. APPL'D FOR' indicates manufacture between June 26, 1889 and early 1890. The pedestal and the pan were cast on this version, so his brilliant use of sheet metal is less apparent.
Photo B Wright

Patent No. 533,166 show that Dr. Fitch filed his application in 1892 and renewed it in 1894. At this time in his life he had moved to Utica, New York, the state of his birth, and was still a practising physician. While the patent drawings look quite different from the scale itself, there is enough similarity to suggest that it is a modified version of its patent, as was my 1888 scale. For several years I was unaware of any other Fitch scales like this one. And then....

While preparing this article I had several surprises. Firstly, Betty Wright sent pictures of an identical scale packed in a box marked "PAT. APPL'D FOR" (Fig. 7.) Next, George Anna Wehman supplied photographs of an identical scale packed in a box inscribed "PAT. JAN. 29 1890"!

The knowledge of this unsuspected patent sent me back to the library to see what more could be learned. My first discovery was the existence of an alphabetical index of patentees registered in 1877 and later - a tremendous time-saver. Next, I found that patent dates are sometimes misquoted. Despite the date on the box-top, Patent No. 418,708 was actually granted on January 7, 1890 (Fig. 8).

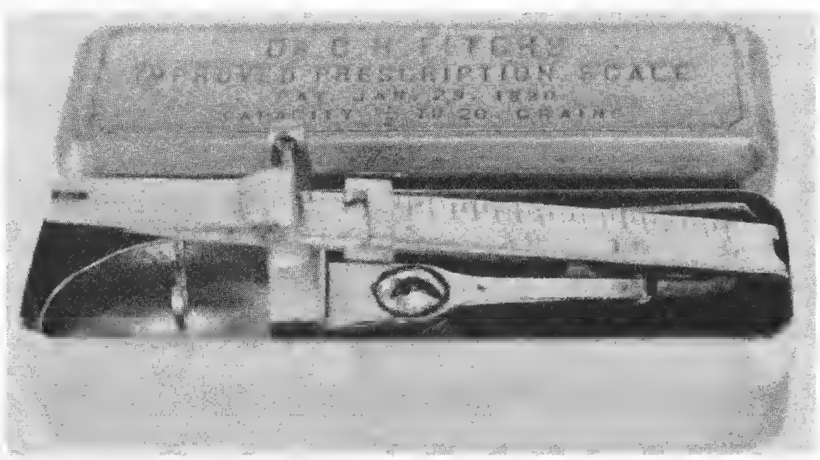


Fig. 8. Scale and spatula stored in box; box reads [erroneously] 'PAT. JAN 29, 1890'. The overall size of the box is reduced by using an oval pan rather than a round pan. The prominent knob below the beam secured the frame to the pedestal. Photo G A Wehman

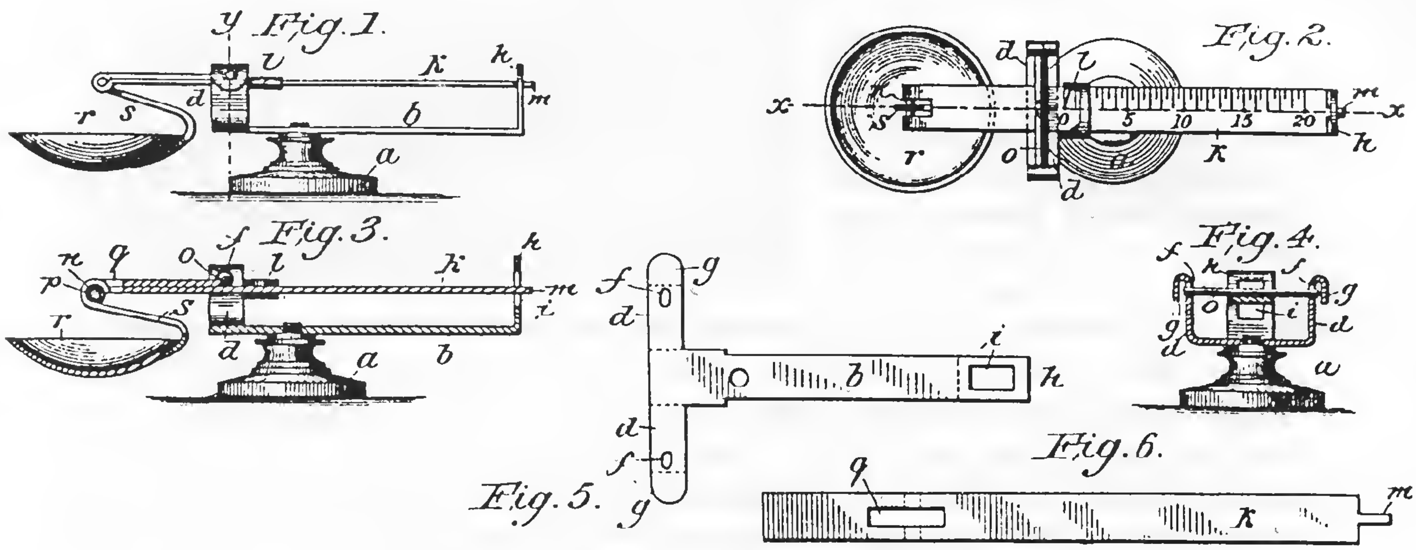
By 1889, when he applied for this third patent, the doctor was again living in Middletown Springs, VT. He returned to his original concept of a pocket scale while introducing significant improvements: "*The frame thus constituted may be produced from a single piece of metal (preferably steel) by punching out the same in dies or by press and thereafter bending the various parts as described and thus the said frame may be produced very economically and also very accurately.....The pan is provided with a suspending-hook curved upwardly....so that its bearing surface will be substantially in the center of the pan. The pan is saucer shaped by preference, and it is not necessary that the material to be weighed therein shall be deposited in any particular portion of the pan to secure accuracy.....By unscrewing the base the scale may be packed in a very small box and thus carried upon the person without inconvenience.*"

Fig. 9 Patent No. 418,708; application filed June 26, 1889, patent granted Jan. 7, 1890. Improvements include a bearing plate fashioned from a single piece of metal, reducing production costs. The curved hanger permits an accurate reading even when the drugs are not centred in the pan.

C. H. FITCH.

PRESCRIPTION SCALES.

No. 418,708. Patented Jan. 7, 1890.



I was left with a real mystery. For some time I had thought that my scale was a variant of the 1895 Fitch patent, and possibly the only surviving example. Now I know it to be an 1890 scale masquerading in an 1895 box. How could that happen? Probably an antique dealer had made what he believed to be the perfect match of components from different sources.

As the proud possessor of what may be the only surviving paper box for the 1895 Dr. Fitch Improved Prescription Scale (Fig. 10) I wonder what the scale itself may look like. The 1895 patent drawings show features of both the 1888 and 1890 models, but there is no way to know what modifications may have been made in the actual scale. I know of only one 1888 scale (without a box) and one 1895 paper box (without a scale). Because Dr. Fitch always put the identification on his boxes rather than on the scales themselves some readers may actually own an 1888 or 1895 scale without having known who made it. If so, I'd like to hear from you!

Dr. Fitch's 1885 invention was by far his most popular, being a product that was marketed throughout the United States. This is evident from the number that are still found in antique shows, shops and

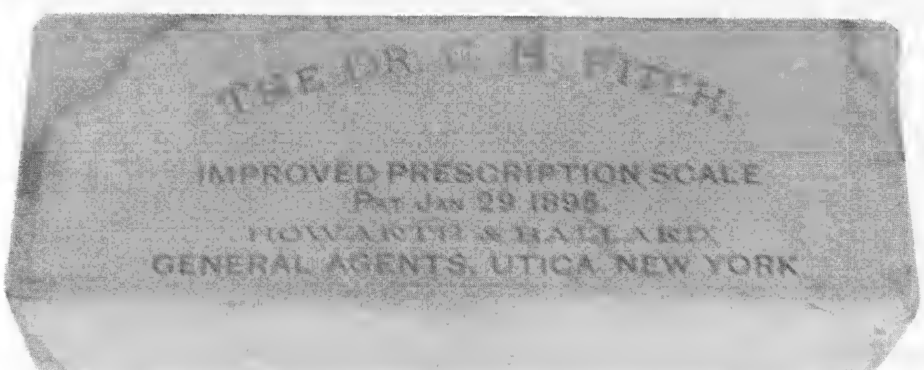


Fig. 10. Paper box for the Dr. C H Fitch Improved Prescription Scale, Jan. 29, 1895. General Agents are Howarth & Ballard of Utica, New York, wholesalers of pharmaceutical, medical and laboratory supplies.

flea markets. These are prized by collectors for their simplicity and compactness and because they were used by nineteenth century physicians and pharmacists. The 1890 scale is seen only occasionally. The 1897 catalogue of a San Francisco pharmaceutical distributor advertises the 1885, 1888 and 1890 Fitch scales, but does not illustrate the 1888 model (Fig. 13).

C. H. FITCH.
PRESCRIPTION WEIGHING SCALE.

No. 533,166. Patented Jan. 29, 1895.

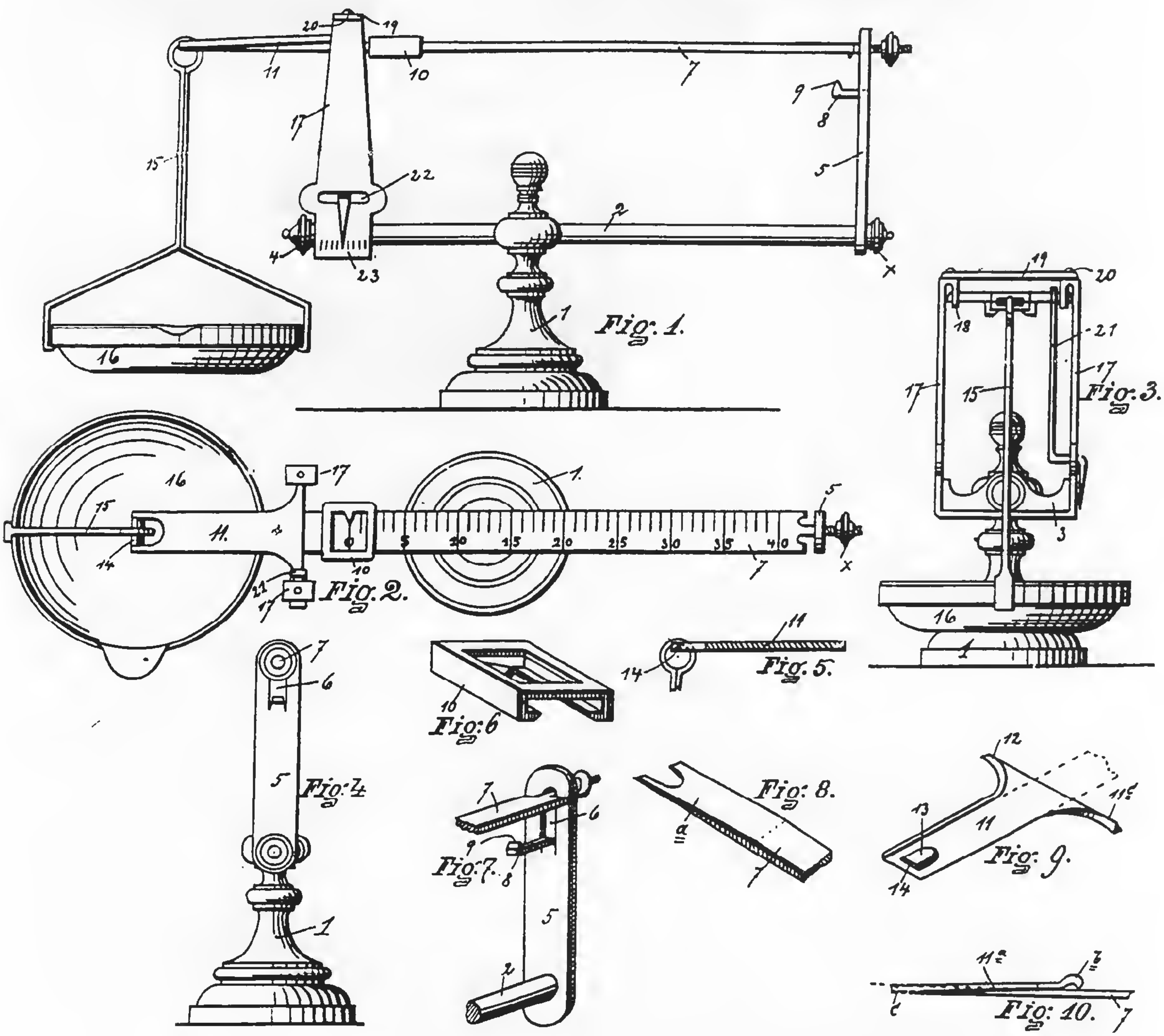


Fig. 11. Drawing of patent no. 533,166; application filed Aug. 13, 1892, application renewed July 2, 1894, patent granted Jan. 29, 1895. As proposed, Dr. Fitch's fourth scale has an angularity resembling his 1888 patent drawing (Fig. 5). It is designed with a central pedestal, a pan with a pouring lip suspended from a pivot in an extension of the beam, a screw to adjust for equilibrium and a vibration check-arm. The single beam is graduated from 1 to 40 grains, twice the capacity of his previous pocket scales. Unlike any other Dr. Fitch scale, it has a prominent vertical indicator arm at the fulcrum end of the beam. (See the text of this patent in Fig. 12.)

Fig. 12. Text with patent 533,166, granted Jan 29, 1895.

To all whom it may concern:

Be it known that I, CALVIN H. FITCH, of Utica, in the county of Oneida and State of New York, have invented certain new and useful Improvements in Prescription Weighing-Scales; and I do hereby declare that the following is a full, clear, and exact description of the invention, which will enable others skilled in the art to which it appertains to make and use the same, reference being had to the accompanying drawings, and to the letters and figures of reference marked thereon, which form part of this specification.

My present invention relates to an improvement in prescription scales, more particularly adapted for apothecaries' and physicians' use.

In the drawings which accompany and form a part of this specification, and in which similar letters and figures of reference refer to corresponding parts in the several views, Figure 1 shows in side elevation my improved scale. Fig. 2 shows a top view of the same with a small connecting bar removed to better illustrate the construction. Fig. 3 shows an end view of the device as seen from the left of the Figs. 1 and 2. Fig. 4 shows the right hand end of the device as seen in Figs. 1 and 2. Fig. 5 shows the fulcrum piece which is applied to the end of the beam, in section, also showing a portion of the upper end of the pan hanger. Fig. 6 shows the weight or counterpoise. Fig. 7 shows in perspective a portion of the right hand end of the scales as shown in Fig. 1. Fig. 8 shows the fulcrum end of the beam. Fig. 9 shows the fulcrum piece as seen from the under side and which is secured to the end of the beam shown in Fig. 8. Fig. 10 shows a modified form of construction of the fulcrum piece in connection with a portion of the beam.

Referring more particularly to the reference numerals and letters in a more specific description of the device, 1 indicates the base in which is secured supporting rod 2, which projects on either side of the base and has secured at one end the head 3 by nut 4 on the end of the supporting rod 2. On the opposite end of the rod 2 is provided a check arm 5 provided with an opening 6 in which the projecting end of the beam 7 plays. At the lower end of the opening 6 is provided a projecting arm or post 8 formed from the metal punched out of the hole and which is provided with a sharp point or edge 9 on which the end of the beam rests when in its lower position and which acts as the lower check or stop therefor. On the beam 7 is provided a movable poise 10 adapted to be moved along the beam 7. The beam is divided or marked off with marks and figures in the usual manner of a scale beam. The pan end of the beam 7 is tapered, as shown at *a* in Fig. 8; the taper making an incline downward from the point of the beam adjacent to the fulcrum toward the pan end of the beam. Secured on this tapering end *a* of the beam by soldering or in any other suitable manner, is provided the fulcrum piece 11, which is formed as shown, with L shaped projections on either side of the body of the piece which form fulcrums 11^c and 12. In the opposite end of the fulcrum piece 11 is provided an opening 13 and the portion of the piece between the opening 13 and the end is sharpened on the upper side to furnish pan supporting knife edge pivot 14.

It will be observed that the taper or incline *a* formed on the end of the beam 7 is such as to bring the fulcrums 11^c and 12 on line with the top surface of the beam and the pivotal edge of the pan hanging pivot 14 in the same line with the fulcrums 11 and 12 and with the upper surface of the beam. By means of the hanger 15 a pan 16 is supported from the pivot 14. The head 3 is provided with a pair of upwardly extending arms 17, which at their upper ends are turned inwardly and downwardly forming suspended ears 18. These ears are provided with openings in which the fulcrums 11^c and 12 have bearing. The beam may be put in place by slightly springing the arm 17 apart to allow the fulcrums to be put in their places.

Extending between the upper ends of the arms 17 may be provided a cross bar 19 secured on the upper end of the arm by screws as 20. By providing the ears 18 on the inside of the arm 17, a bearing is secured which is protected by the arm and the fulcrums extending through the ears will abut against the body of the arm 17 and prevent the beam from becoming displaced and still be substantially frictionless if the scales are used with the end of the fulcrum so abutting against the side of the arm. This construction also dispenses with a shoulder at the side of the fulcrum 12 to limit the amount of play which it would otherwise have if the bearings for the fulcrums were provided directly in the arms 17 on the head 3.

Secured on the fulcrum piece adjacent to the fulcrum is an indicator arm 21 which extends downward on the inner side of the arm 17 nearly to the bottom of the head 3 and thence turning at an angle passes through a slotted opening 22 provided in one side of the head and vibrates in unison with the beam opposite a scale 23 provided on the lower portion of the head 3.

The operation of a scale is too well known to require description.

I have provided a check having a sharp point or edge 9 on which the scale beam does not adhere to any appreciable extent, thus overcoming the adhesive and cohesive forces. I am, therefore, able to provide a scale which is very sensitive to variations in weight placed in the scale pan while the beam is in its lower position. The scales may be entirely dismantled by detaching the pan hanger and removing the strap or bar 19. The beam can then be removed by springing the arms 17 apart to disengage the fulcrums and withdrawing the indicator 21 from the slotted openings 22. The head 3 and the check arm 5 may also be removed by loosening the nuts 4 and *x* which secure them.

In the modified form of construction shown in Fig. 10, I provide in lieu of the piece 11 shown in the other figures, a piece 11^a which has the fulcrums formed and brought on to a level with the upper face of the beam by a turn or bend *b* provided therein. This fulcrum piece is stamped by a die from a sheet of metal and in turning the bend, the under side of the pin becomes one of the walls of the knife edge of the fulcrum and the fulcrum bearings are easily completed by simply filing off on a bevel the end of the fulcrum piece. The pan hanger pivot *c* provided in the end of the piece 11^a is also in line with the upper surface of the beam, as will be seen by the dotted lines in the figure. As the fulcrum piece contains both the fulcrums and the pan hanging pivot, these points are invariable with reference to each other and the fulcrums and pivot may on that account be more perfectly mounted on the beam than is otherwise practicable. The position of the pan hanger pivot *c* and the fact of its being brought into line with the upper surface of the beam is determined by the inclined tapered end of the beam on which it is secured, as described with reference to the other figures.

What I claim as new, and desire to secure by Letters Patent, is—

1. In a scale, the combination of a scale beam having a beveled end sloping from the pivotal point downward toward the pan hanging end, and a fulcrum piece having fulcrum projections extending to either side of the beam and a pan hanging pivot in the end of the piece the fulcrum piece being secured on the beveled end of the beam, substantially as set forth.

2. The combination of a scale beam and a check arm having an opening in which the end of the beam vibrates, an arm projecting from the lower edge of the opening below the beam and having a sharp edge on its end on which the beam rests in its lower position, substantially as set forth.

3. The combination in a scale, of a beam having fulcrum arms projecting from either side, a head having a pair of upwardly extending arms in which are provided bearings for the beam fulcrums, one of the arms having a slotted opening adjacent to its base, and a scale beside the opening and an indicator arm secured to the fulcrum arm between the bearings and extending to and bent to pass through the slotted opening, the indicator point vibrating in unison with the beam in front of the scale, substantially as set forth.

4. The combination of a beam having fulcrum arms extending from either side thereof, and a pair of beam supporting arms, each having an inwardly turned perforated ear 18 in which the beam fulcrums have bearing, substantially as set forth.

5. The combination in a scales of a beam having a tapering end and a fulcrum piece formed out of a plate with sharp bend in one end of it whereby the fulcrums are brought into line with the upper surface of the beam and provided with a pan hanging pivot in the opposite end of the piece, also in line with the upper surface of the beam, substantially as set forth.

In witness whereof I have affixed my signature in presence of two witnesses.

CALVIN H. FITCH.

Witnesses:
WILLIAM FISHER,
G. W. ADAMS.

In researching this article I began with the patents, which not only illustrate and describe each invention but also name any assignees and give the patentee's place of residence on the date the application was filed. Additional details about the patentee, his family, his manufacturers and his

distributors were supplied by federal census records and correspondence with the public libraries in Richmond, Virginia, and Utica and Oneida, New York, as well as the Vermont and New York historical societies.

As a sidelight, while locating Dr. Fitch's patents, I discovered that in 1882, 1883, 1884 and 1887 he had patented another series of inventions - bedsprings. Quite a difference from a pocket-sized scale!

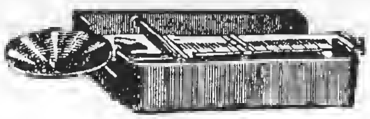


Fig. 541.

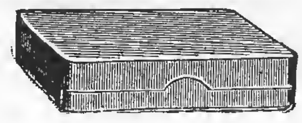


Fig. 542.

Scales, Fitch's Pkt. Prescrip., with Folding Spatula (Fig. 541) ......doz. \$ 9.00
Size when closed, 2¾x1½ inch (Fig. 542).

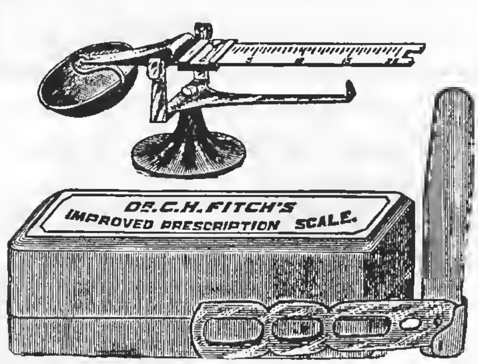


Fig. 543.

Weighs with equal facility from ¼ grain to 1 ounce, and in the metric system from 1 centigram to 30 grams.

Scales, Fitch's Improved Pocket (Fig. 543).............................doz. \$ 9.00
" Combination Prescription..........................each 7.50

Fig. 13. Langley & Michaels Co, Importers, Wholesale Druggists and Manufacturing Chemists of San Francisco, offered three Dr. Fitch scales in their 1897 catalogue. Fig. 541 'Fitch's Pkt. Prescrip.' and Fig. 543 'Fitch's Improved Pocket' cost \$9.00 per dozen and probably retailed at \$1.50 apiece. Since the statement 'Weighs with equal facility from ¼ grain to 1 ounce and in the metric system from 1 centigram to 30 grams' cannot apply to Fig. 543, it must pertain to the next entry, 'Fitch's Combination Prescription' (neither numbered nor illustrated), which cost \$7.50 each, consistent with a \$15.00 retail price. This can only be the elusive 1888 scale. Note that three versions were in production simultaneously in 1897.

My interest in scales grew out of a University of California course I took in 1965 on the California Gold Rush. The study of mining led me to the scales the miners used to weigh their gold, (see EQM p 151-158) and from that beginning I have gone on to collect all kinds of precision weighing instruments and books relating to them. It has been an ongoing love affair ever since.

Note from R H Willard:
This comprehensive study of four simple scales by one inventor provides the reader with an inviting introduction to the entire spectrum of collecting American scales, from the thrill of acquisition through the sometimes Byzantine process of identification to the perils of accepting at face-value everything one sees in print.

Readers will be quick to notice that the terminology, abbreviations and pinctuation vary from patent to patent and from scale box to scale box. We have quoted these exactly as used to reflect the flavour of life in late nineteenth-century America.

Writer's biography:
William Doniger's comprehensive article on the wide variety of scales used in the field during the California Gold Rush appears in EQM, pages 151-158. He is a founding member and director of ISASC and served as the curator of the Morton Wormser Scale Collection, which is permanently displayed in the University of California, San Francisco, School of Pharmacy Building. He has an antique shop full of small, ingenious scientific instruments and tools, where he encourages beginners, informs the seekers of facts and contributes to the collections of the aficionados, with the assistance of his wife, Mary-Ellen.

Apology from the editor:
Due to a malfunctioning lens in a photocopier, all the patent texts came with a twist on them, so the horizontal lines were distorted and the columns impossible to line up correctly. Please accept my apologies.

Reflections on Dr. Fitch

By R H WILLARD

Fifty-five years old at the time of filing his first patent application, Dr. Calvin H Fitch must have been making house-calls for at least a quarter of a century. With him, he carried all the medications, implements and supplies that might be needed to treat whatever ailments and injuries he encountered. Whenever it was necessary to prepare and administer a dose of medication, he took out a small wooden box containing an equal-arm balance and a set of weights. He put the required weights in one pan and the drugs in the other pan. Then holding the balance in one hand (some could be mounted on their box-tops as in figure 1) he waited to see whether the beam tipped. This tedious process might need to be repeated for each of several ingredients and occasionally a weight might get lost.

Seeking to produce an attractive, compact scale on which small quantities of drugs could be weighed accurately and quickly without the use of detached weights, Dr. Fitch possibly found inspiration in the several ingenious rocker balances patented and put on the US market for use as counterfeit coin detectors between 1853 and 1885. (See EQM, issue 2, 1985 to issue 2, 1987.) Perhaps he adapted that configuration for medical use.

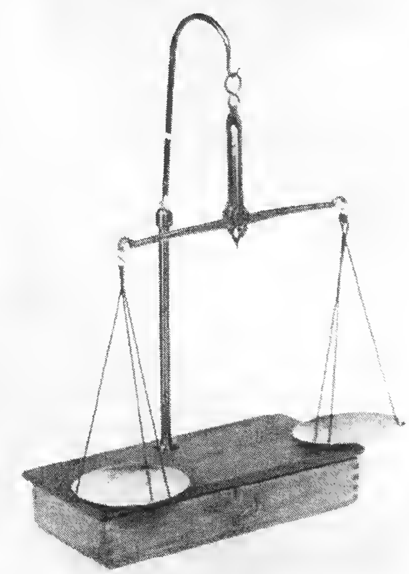


Fig. 1. Simple scale often supplied with inert pans, made usually of glass but sometimes of horn, tortoiseshell, mother-of-pearl or celluloid.

His 1885 patent is a true rocker, having the pan on the beam and requiring that the load be located exactly for a correct read-out (for a similar dental scale of unknown date, see page 2056, or Crawforth's Handbook page 65, Fig. 23). His subsequent patents are for steelyards with the pan suspended below the beam, making for a speedier weighing since the load need not be centered so precisely in the pan.

Judging by their popularity, his 1885 and 1890 pocket scales, roughly three inches in length when boxed, and having a capacity of just 20 grains (1 scruple or one twenty-fourth of an apothecary ounce) satisfied a real need amongst physicians and others. The 1895 scale with its capacity of 40 grains, while perhaps a bit large for carrying in a pocket, is still considerably more compact than the box needed to hold an equal-arm balance having similar capacity.

Encouraged by the popularity of his first scale, Dr. Fitch attempted to incorporate the same principles

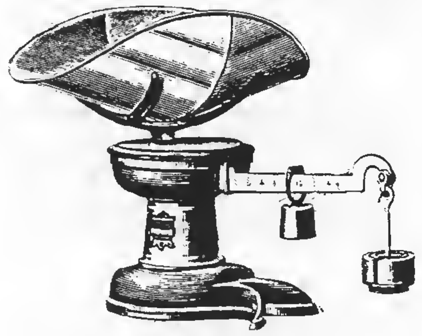


Fig. 2. Howe 1883. Capacity 1 drachm-8 lbs. Price $10.00.

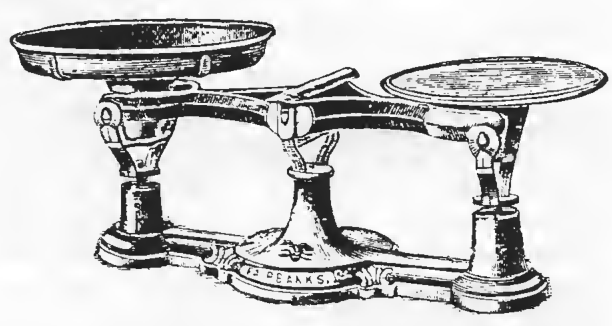


Fig. 3. Fairbanks 1891. Druggists' Even Balance Trip Scales. Capacity 2 lbs. Cheapest version $6.50.

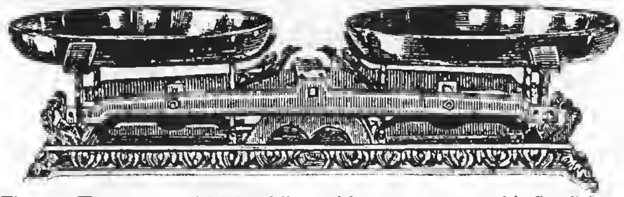


Fig. 4. Troemner 1899. All working parts set with flexible steel bearings. Capacity 1 drachm–40 lbs! $32.00.

Fig. 5. Troemner 1899. Climax Box Prescription Scale. Mahogany box about 12 in wide. Marble slab, so very heavy. Not for travelling. $12.50.

into a prescription-compounding scale for pharmacists. Like the first model, the 1888 Combination Prescription Weighing Scale provided the convenience and compactness of a one-pan scale having permanently installed weights. It could be taken apart and packed in a small box for easy portability. And looking to the future, Dr. Fitch devised a steelyard beam that could accomodate both the new metric and the old apothecary units. Innovative, attractive and convenient to use, the scale seemed destined to become a prestigious addition to any pharmacy.

Why then, is the 1888 Combination Prescription Scale so rare? It must not have been commercially successful. Was it too expensive to produce? We know from the Langley & Michael's catalogue that it was offered for sale at least as late as 1897 and that its price was lower than that of any other dispensing scale advertised by them

Probably Dr. Fitch did not understand the market he was attempting to reach. First of all, since a druggist has no need to take his scales away from the pharmacy, portability was irrelevant. Secondly, while the use of the metric system had been permissible in the United States since 1866, it was adopted far more quickly for analytical, assay and pulp balances than for medical use. American physicians continued to write prescriptions in the familiar apothecary units for several generations and have adopted an exclusively metric notation only within the past 15 years.

Thirdly, and probably most importantly, Americans had long been accustomed to seeing precious and valuable substances like gold, gems and drugs weighed in small amounts on equilateral balances with the pans suspended from the beam. Single-pan scales were generally associated with utilitarian commodities that were sold in large quantities. For weighing such items as household or veterinary drugs Fairbanks, Howe, Buffalo and probably other makers, advertised steelyard Druggists' Scales "*indicating drachms, ounces and pounds, capacity 8 pounds.*" This description undoubtedly refers to the avoirdupois drachm of 27 $^{1}/_{8}$ grains or $^{1}/_{16}$ ounce, since several of the catalogues describe the scale's capacity as "from $^{1}/_{16}$ ounce to 8 pounds." However, at least one of these scales was also "*adjusted to troy (apothecary) weights. They operate with great delicacy and are reliable for weighing valuable metals, costly drugs, silks, &c.*" according to a Fairbanks 1865 catalogue. That scale probably suggested the dual graduations on Dr. Fitch's 1888 prescription steelyard.

Fitch's application of the steelyard mechanism to fine weighing may well have been inspired by an unusual Fairbanks dispensing scale patented in 1872 (see EQM, page 143) and in 1878 (Fig. 6). Similar in size and having slightly less capacity than the Fitch, this consisted of a black-painted cast-iron base with a single nickel-plated brass beam, graduated to weigh 1 to 8 drachms by ½ drachm between the fulcrum and the indicator and 1 to 30 grains by 1 grain between the fulcrum and the pan. All of the examples of this scale shown in EQM (see pages 73, 143, 805, 1028 and 1422) show an attached moveable counterpoise that can be adjusted to balance (tare) the pan being used.

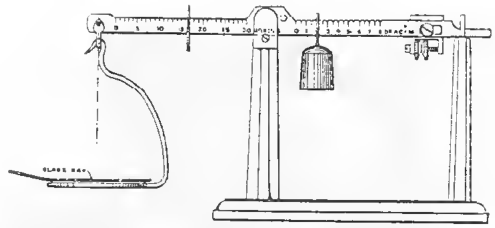


Fig. 6. Fairbanks 1872 patent, still being sold in 1906. Cheapest version $5.00. Capacity 8 drachms.

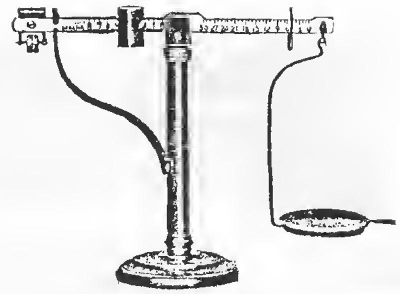


Fig. 7 Fairbanks 1906 version with pedestal.

The 1906 Fairbanks catalogue offered the scale with an alternative pedestal base resembling the Fitch design (Fig. 7). Scales produced after 1919 incorporate a spirit-level in the base - a feature that Dr. Fitch proposed in his patent application but did not include in his actual scales.

These Fairbanks scales were never approved for use in Britain because the instrument was not sensitive enough to turn when $^1/_5$ grain was added or subtracted from the load (the necessary sensitivity for a scale weighing only 1 ounce), because it was an accelerating machine, and because it was considered that dirt or verdigris in the notches could cause errors. Additionally, the adjustment screw had a range of adjustment out of all proportion to the capacity of the machine and might reasonably be held to facilitate fraud.. In the United States, the design was also adapted for use in weighing cloth, tea, gunpowder and photographic chemicals, perhaps more suitable commodities in the light of the criticisms above.

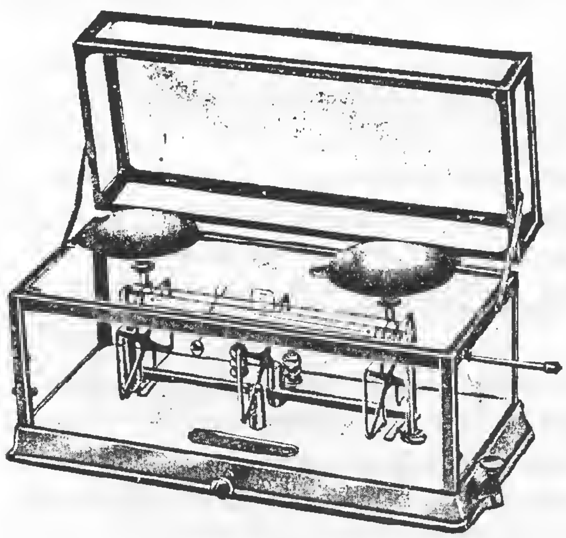


Fig. 8. Torsion Balance Co 1915. Capacity 120 grains (4 ounces.) Sensitiveness 2 milligrams. German silver pans. Upper rider beam indicates 8 grains by $^1/_8$ grain. Lower rider beam indicates 10 grains by $^1/_{16}$ grain. Price $40.00 so the most expensive choice for a pharmacist. Cheaper versions were available, but in opaque boxes, so that the lovely mechanism was concealed.

Even given the traditional preference for weighing precious substances on equilateral scales, the Fitch Combination Prescription Scale might have been widely accepted but for the invention of another physician. In 1882 Dr. Alfred Springer and Prof. Frederick A Roeder established the Torsion Balance Co. in Cincinnati, Ohio, after receiving a patent for a radically different weighing technology in which the knife edges or other bearings are replaced by tensioned steel bands and pivoting is achieved by the torsional twisting of the band. Torsion Balances, graduated in both grains and grams, quickly dominated the market for prescription compounding scales. They are widely used today, although the latest scales are electronic. While this development was unfortunate for Dr. Fitch, it does assure collectors that anyone who owns an 1888 Combination Prescription Scale is the possessor of a genuine rarity.

Acknowledgements:

Ruth Hendricks Willard extends a special thank-you to Registered Pharmacist Chris Economou, who graciously verified our recollections of the scales and their use in the Hendricks family drug-store in years past and also provided information on current practices, and to Dale Reed, who shared his professional knowledge of the scale industry.

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Writer's biography:

Ruth Hendricks Willard is a historian whose diverse projects include authorship of two monographs and a curriculum guide, locating archival images for a public television docudrama that won a regional Emmy (television's equivalent of the movies' Oscar) and important roles in three major exhibitions. In 1990 she received a commendation from the American Historical Association *'in recognition of her service to the historical profession and her work in bringing into harmony elements of business, the university, religions and the community at large.'*

Metrologically, she was the only United States presenter at the International Committee on Historical Metrology's Sixth Congress, edited Appendix 3 of D & J Gear's book *Earth to Heaven* in 1992, and contributed an essay on Egyptian metrology to the forthcoming *Encyclopedia of the History of Science, Technology and Medicine in Non-Western Cultures,* to be published by Kluwer Academic Pub, Netherlands, in autumn, 1996.

Prior to assuming her responsibilities as associate editor of EQM, she edited the Newsletter of the National Coordinating Committee on Women in History. She is a charter member of ISASC.

Dr. Fitch's Descendants

By D CRAWFORTH-HITCHINS

The ideas originated by Dr. Fitch still have their place today, in compact steelyards packed into little boxes to carry in the pocket. The function of these cheap plastic objects must be deduced from the internal evidence.

Figures 1 and 2 show the "DEERING PRECISION INSTRUMENTS GRAM SCALE, PATENT NO. 3,968,849. MADE IN USA." The silver and black label is stuck into the underside of the lid, and leads to speculation as to the meaning of the word "PRECISION" in this context.

The scale-box is 3 x 1½ x ¾ in (75 x 40 x 27 mm), very reminiscent of a Dr. Fitch's scale in size and shape, but made of pistachio-icecream-green plastic! The fulcrum is at the left hand end of the box so

that the user must turn out the fork that supports the pan, and drop the pan into the Vs so that the pan swings freely, clear of the box. The central fulcrum comprises a rod of brown plastic of diamond-shaped section which rests at its ends loosely in two sheet-metal vertical plates acting as bearings. The plastic rod was slipped through the centre of the hinges of the beam when it was assembled.

The beam has a piece of printed plastic glued to its top surface graduated in grams (0-2 by twentieths of a gram) and in carats (0-10 by ¼ carats), with a metal rider-poise curled round the beam, and prevented from sliding too rapidly by a roughened edge on the beam.

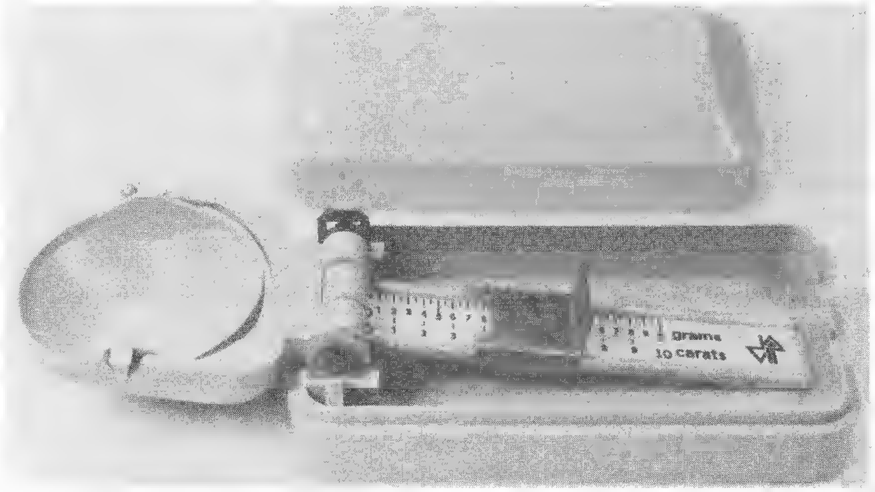

Fig. 1. Deering Precision Instruments Gram Scale. Compare it with Fig. 1 on page 2038. This scale has a suspended pan so is not a rocker. On the paper box are instructions in English and French.

With the poise set at 1 gram the load needed to be 1.15 grams to bring the beam to horizontal, (or, reading the lower graduations, with the beam set at 5 carats, the load had to be 6 carats!) Would any diamond dealer contemplate using such an inaccurate scale? Willard comments on page 2049 that the scale collectors should not believe all they read in print. Add "and do not believe in all the graduations on scales"!

Presumably the scale was intended to weigh in grams, and in the 1980s in the USA when this scale was bought, one small item sold in grams was drugs. The manufacturer could claim, if challenged, that the scale was multi-purpose, and technically that was correct, but putting carats (used in Europe only until about 1900) on the chart lacks verisimilitude!

Any reader who could investigate the patent to ascertain what aspect of the scale was patented, over and above the claims of Dr. Fitch, might write to the editor so that all members can share the fun!

The second Dr. Fitch derivative is shown in Figure 3. The only detachable part is the swinging pan, which can be stored below the fork on which it swings, but it is still very small, with the base 3½ x 1½ in (87 x 40 mm), and the scale 1¼ in (30 mm) high.

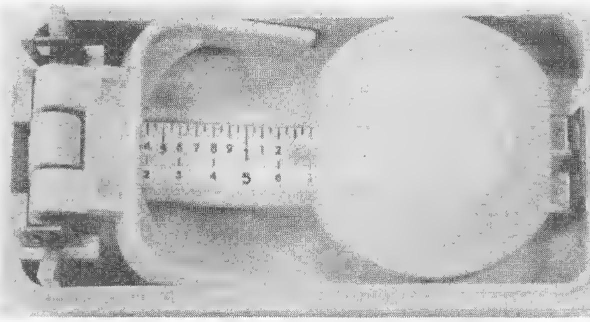

Fig. 2. The Deering Gram Scale shown folded. It does not have a spatula, which would be useful for loose powdered substances. The paper box has 'Sole Distributor USA: Adam's Apple Distributing Co. Chicago, Illinois 60640.'

All parts are made of black plastic, except for the brass rod screwed to the bottom of the plastic rider-poise. Even the bearings are made entirely of plastic. The graduated chart is glued onto the side of the beam, graduated 0-2 grams by twentieths. An adjustment screw is placed across the fulcrum, so that, when it is screwed along to the left, extra weight is applied to the beam, and when it is screwed to the right, extra weight is applied to the load. If the reader suspects that this allows the perpetration of fraud, who could disagree?

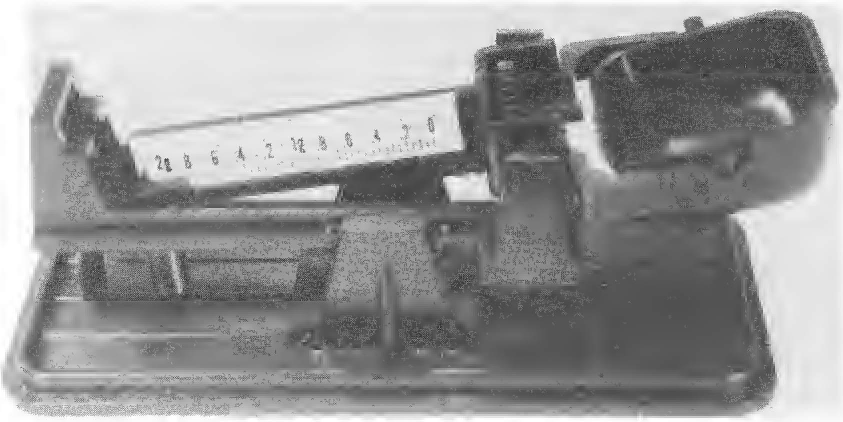

Fig. 3. The Magic Dragon Ent. Gram Scale, made of black plastic. The pan can be stored under the fork. A tapering black lid drops over the scale and clips onto the base.

The rider-poise is a block of plas-tic $^2/_5$ in (8 mm) long, wrapped round the bottom of the beam with a protrusion below the block onto which a rod is rigidly screwed. Thus, the line of displacement (sliding path) of the centre of gravity of the poise lies well below the plane defined by the putative knife-edge. Consequently, the sensibility becomes, to a great measure, dependent upon the load, and in addition the sensitivity will be very low.

Cast into the base is "MAGIC DRAGON ENT. ENGLEWOOD, COLO. PAT PENDING", which turns the thoughts towards banned substances.

Testing the "Magic Dragon" with the screw towards the pan, when the poise is at 1 g, it takes 0.95 g to tip the beam to the horizontal. With the screw tight against the graduated chart, it takes 1.1 g to rise. In fact, by jiggling the pan in its V-bearings, and shifting the fulcrum, it is eay to get a range of readings between 0.95 and 1.4 g with the same load. As the purity of drugs is said to be unreliable, perhaps it does not matter that the quantity of the load is also unreliable, and merely giving an appearance of fair trade to a transaction.

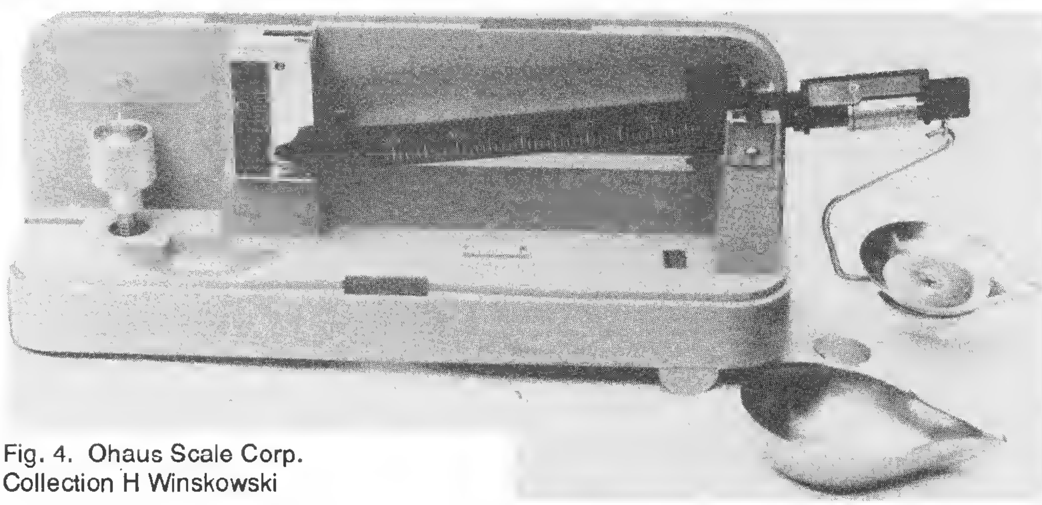

Fig. 4. Ohaus Scale Corp.
Collection H Winskowski

The third little scale (Fig. 4) is not so similar to Dr. Fitch's scales, but is also a dismountable steelyard for prescription weighing. It was made by Ohaus Scale Corp, US patent no. 227,700, date not known.

The beam is graduated 0-50 grams by 1 gram, which seems crude, but it has a micrometer screw on the pan side of the fulcrum which indicates tenth parts of a gram. The beam's horizontality can be gauged exactly by reading off the chart at the tip of the beam. It has a loose pan. There is a slot in the case into which it is fitted for transporting. Can any member identify the function of the knurled knob on the left with the loop of wire protruding from the top?

Showcase

Very attractive brass weight with 'ONE OUNZES' and 'J. L. B.' with the traditional apothecaries' symbol for 1 oz in the centre of the weight.

See Biggs' *Apothecaries Weights An Outline Catalogue*, no. 1240 for the full set of eight weights of drachms and scruples. J.L.B. has not been identified, even though his weights are found in Britain regularly. As his weights are also found in America, possibly he was an American maker.

Collection L uit den Boogaard.

Chrome-plated dental amalgam scale. A rocker, technically. Stamped into the base 'ADCO BALANCE' and 'MADE IN ENGLAND'. 7 in (175 mm) long. Capacity 60 [grams] (maximum of 30 grams of each ingredient). Two rider-poises, so that two ingredients could be added to the pan one after the other, before emptying the pan. The pan is conical so that the load is located always at the same position on the beam. The paper box states 'UNIVERSAL ALLOY BALANCE. MANUFACTURED IN ENGLAND BY The Amalgamated Dental Company Ltd. London, Eng.' The steelyard is taken off the base for storage.

Other dental amalgam scales are similarly small and portable, but dentists have not visited their patients since the very early 20th century, preferring to work in a dental surgery, so why the emphasis on compactness?

Collection Sheffield Museum.

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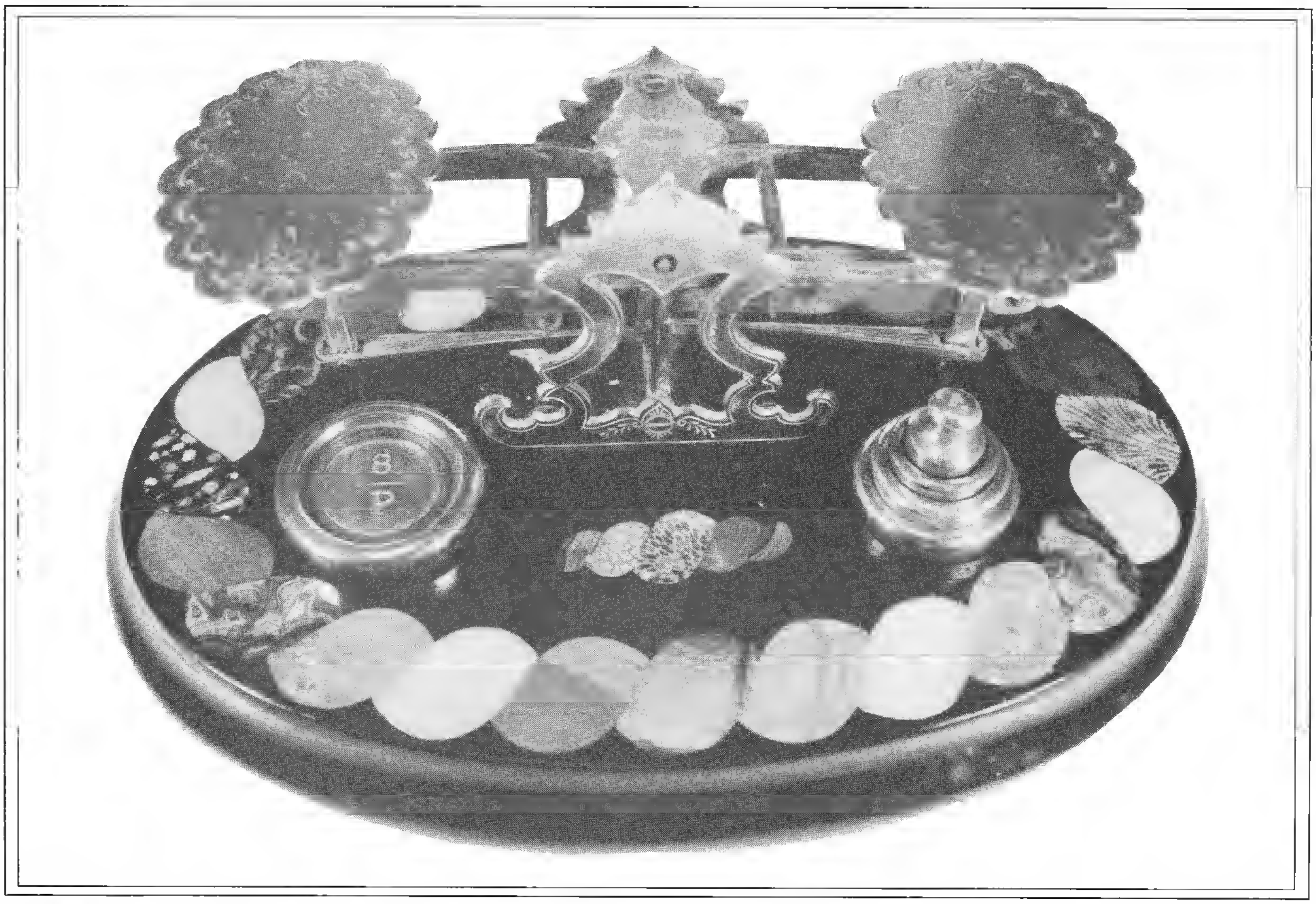
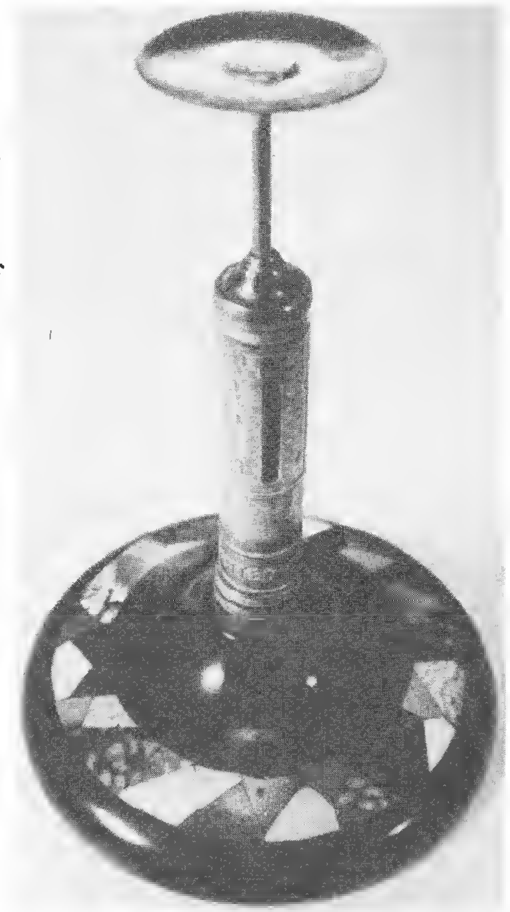


Showcase

The postal scale on the cover was made by S Mordan for a retailer in Torquay ~ a smart resort on the south coast of England where rich people took their holidays. One difference between the designs of S Mordan and those of his competitors was that Mordan ornamented the brass-work in a befitting manner to suit the elaboration of the base, whereas other makers normally put a plain brass roberval with their fancy bases.

The anonymous postal candlestick has a similar base to that of the roberval on the cover. Both have black marble bases inlaid with natural stones, chosen for their vivid colours and strong patterns. The spotty, evenly streaked patterns are the fossil remains of corals and primitive sea-creatures. The candlestick was probably made in Birmingham and the Mordan was made in London but the similarity between the bases gives force to the argument that companies specialised in producing bases to sell to any manufacturer of fancy goods.

Both R Axelrood collection.



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Unpatented American CCDs

and Other Enigmas

BY A G MALLIS

From the day I saw - and bought - my first counterfeit coin detector [CCD] at a numismatics sale in the late 1950s, I have been fascinated with these ingenious instruments and eager to learn more about them. I quickly found that very little had been published about American CCDs. Here was a challenge too enticing to overlook. I resolved to locate and record every U.S. patent and then, in time, acquire a scale representing each one.

My opportunity came in the 1960s, when business took me to the Washington, D.C. area on a weekly basis. By arriving the evening before, I could often complete my work in time to spend an hour or two exploring the records of the U.S. Patent Office before catching a flight home. This was a time-consuming and horrendous undertaking inasmuch as the files were then (and still are) in card indexes, grouped by subject, and the file names do not follow any logical delineation. For example, patents of an identical type might be found under various classifications: *Coin Scale, Coin Tester*, or simply *Scale*. Even greater confusion resulted from the discovery of the McNally- Harrison CCD, patented February 28th, 1882, classified under *Design: For Scales.*[1]

When searching for the documentation of an actual scale familiar to me, I needed only to go through every possible classification looking for either the inventor's name or the date. On the other hand, since I was seeking to locate and record every CCD patent ever issued, I had to examine the drawings and descriptions of every scale, balance, weighing machine, coin scale, etc., ever patented to see which ones were actually CCDs.

After several years of searching through the card index I happened to learn of the existence of the Commissioner's Annual Report, later called the Annual Index of Patents. These volumes, which have been published by the Patent Office since 1839, provide virtually the only public access to patents alphabetically by the inventor's names. I had never thought to enquire about the existence of such an index, and no one had ever thought to tell me!

There was yet another complication. The U.S. Patent Office apparently had no accessible record of the 9,957 patents granted between the passage of the Patents Act of 1790 and the establishment of the present Patent and Trade Mark Office on July 4, 1836. Finally, around 1980, at the library of Worcester Polytechnical Institute, I came across a recently-published subject-index of all patents issued from 1790 to 1873. By 1984 I had found a total of thirty patents dealing with mechanical counterfeit coin detecting mechanisms, combination letter scales / counterfeit coin detecting mechanisms, and several miscellaneous types.

Although I have now documented forty-three such patents, I still have an uneasy feeling that there may be more somewhere. Through the years, there has been some confusion in the minds of the Patent Office authorities as to what is or is not a coin scale or CCD and there have been several instances of reclassification for no apparent reason.

I have, however, reached three conclusions. Firstly, some patented CCDs, if made at all, were produced in abbreviated, barely recognisable versions of their patent documents. Secondly, a number of CCDs were made but apparently never patented. Thirdly, not only the scales but the actual patent papers may be missing for several patents listed in the Subject Matter Index.

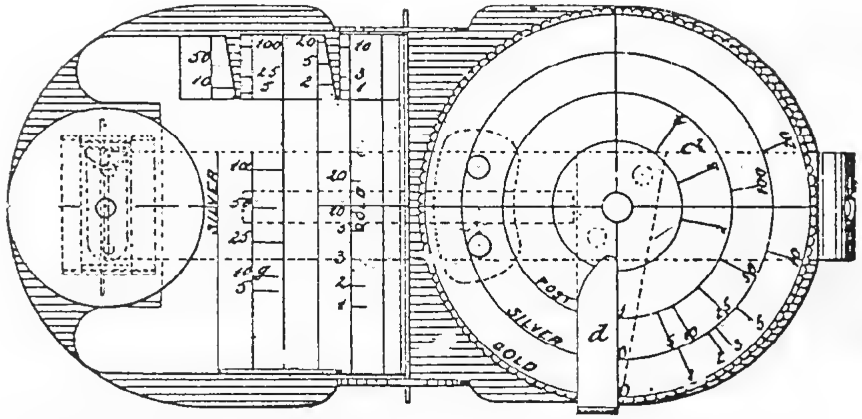


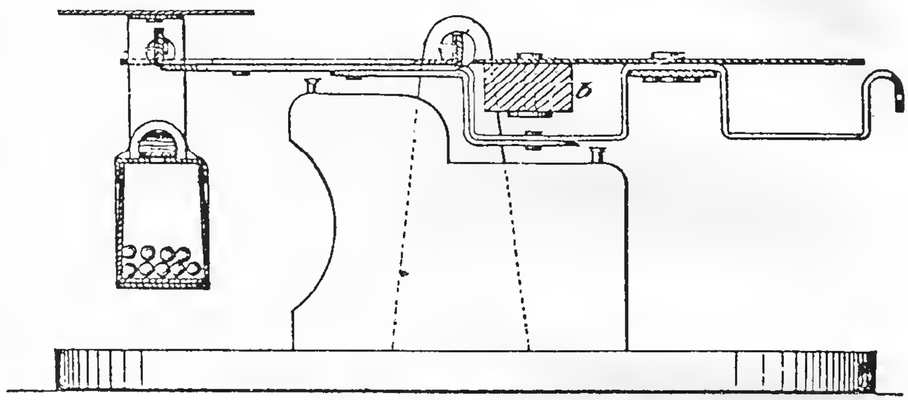
Fig. 1. Harvey Maranville's Patent No. 203,057 of 30 April, 1878.

Having a pivoting pan, this design was for a proper scale, not a rocker.

As shown in this drawing, the scale was for a desk, being 2" high. Lead shot in the box below the pan was to keep the pan horizontal (Schickert's principle.)

When the pan on the left was loaded, the disc on the right had to be rotated until the beam tipped up from its rest. Then the appropriate (postal, silver or gold) concentric circle was read off against the fiducial edge of the finger, d.

The disc was circular, but it had a poise, b, screwed to one edge, so its centre of gravity altered as it was rotated.



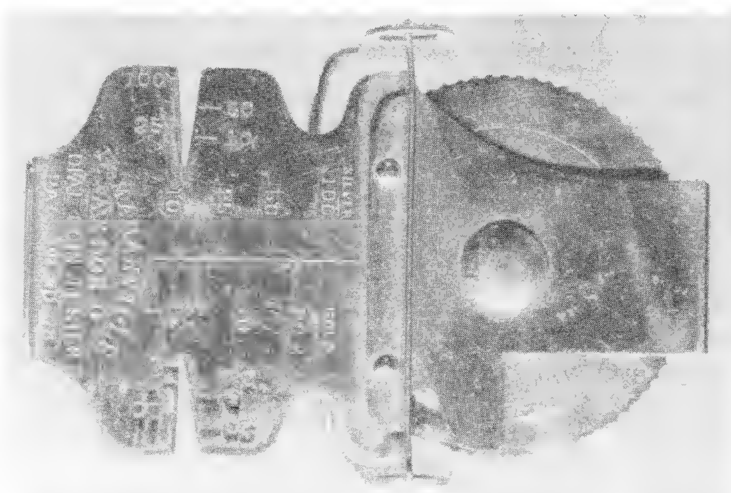


Fig. 2. Maranville's CCD, as produced. As the coin has to be placed on top of the beam, it is not a scale but a rocker. The function to weigh letters has been omitted entirely.

The stand has been omitted, so that the light support is a mere ½ " high. It could now go into a pocket, usefully.

It is a practical rocker that will check eleven coins rapidly and effectively.

Even with the inclusion of material owned by other collectors, I am still some distance from the goal of matching each patent with an example. Lest some collectors be deceived, the actual commercial product as put on the market often bears little resemblance to its patent drawing. This is especially true of combination-devices to weigh letters as well as coins. Witness the 30th April 1878 Maranville Patent No. 203,057 (Fig. 1). The patent shows a plate for weighing letters and other small objects. In production, the letter carrier and much of the base were omitted (Fig. 2). The upper part of the device were set upon a very small C-shaped base with two vertical ears pierced near the top to receive the fulcrum. This base swivels around under the device when not in use. The coin is placed against the lip at the left-hand end while the rotating counterbalance

wheel is turned to the premarked setting for each coin to be weighed. Thickness can be tested by pushing the coin into the proper vee slot (top left of Fig. 1) as far as it will go and reading off against the marks. The American Bankers' advertised this device, mailed anywhere in the country, for a price of fifty cents.[2]

The Maranville should not be taken as an isolated case. Examples of other CCDs patented (but perhaps never produced) include the H G Robinson Patent No. 9,844 for a Coin Safe and Detector, the D Cummings Patent No. 39,890 for a Coin and Letter Scale, and the three Combination Letter Scale and Coin Detectors, Patents No. 292,763 issued to E E Purnell, No. 295,809 to C Richtman, and No. 388,138 to E Knight. Even after publishing the respective patents[3] I have yet to see or hear about any of these combined devices. Can any reader shed some light on these elusive inventions?

In addition to these 43 known patented detectors, there are several CCDs known to ISASC members for which no patent papers have yet been discovered. Some of these carry a maker's name and address or a date, while others have no identification on them.

The earliest datable unpatented CCD is shown in Fig. 3. This all-brass rocker has two slotted platters in the beam plus two ingenious turn-over beams having additional platters. By placing these in various positions, it is possible to weigh and gauge 20, 10, 5 and 2½ dollar gold coins. The maker's name, MEYERS & CO. PHILA, stamped on the counterpoise, places this CCD within the period 1840-1852/53, when Frederick Meyer and Henry Troemner (the "& Co.") were partners.[4]

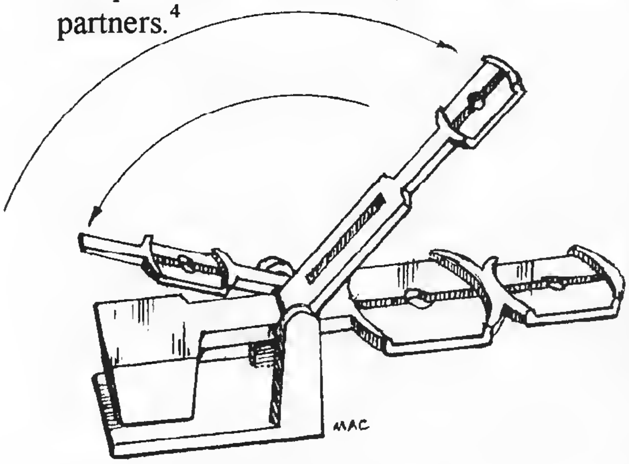
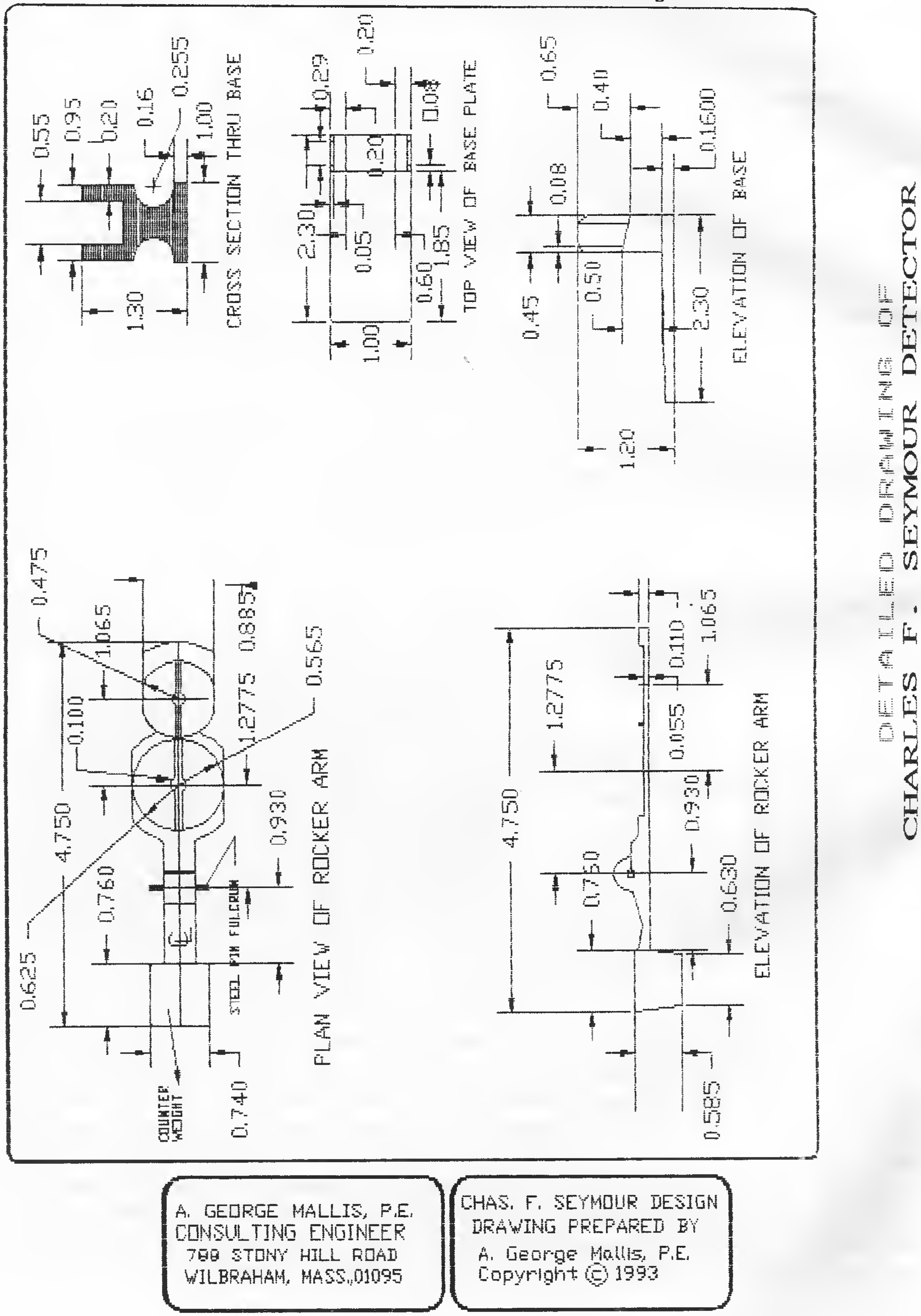


Fig. 3. Meyer & Co. The 2 swing-over beams play no part when the 20 & 10 dollars are weighed, applying no pressure to the poise. Each locks onto the poise when turned to the right-hand end.

Three of these unpatented CCDs are virtually identical; simple cast-brass rockers having pans on the longer arm for the quarter and the half-dollar, while the end of the shorter arm has the integral counterpoise. A genuine coin will pass through the slot in the appropriate pan, fit horizontally within the pan, and depress the long arm. These three are designed to check the diameter, thickness, and weight of the silver quarter- and half-dollar coins of the Seated Liberty type, ca 1839-1891.[5] While an insignificant amount today, a half dollar was about equal to half-a-day's pay for the average workman in 1870.

In 1852 or later, after the dissolution of the Meyers & Co. partnership, Henry Troemner produced what may be the earliest of these, with the counterpoise proudly marked HENRY TROEMNER PHILAD. The second, an unmarked CCD, (Fig. 5, top) differs from the Troemner only in having a bevelled, sliding cover (called a dust-cap by Crawforth) that fits into the top of one leg of the support base. By removing the cover, one can more easily lift out the beam and its fulcrum for cleaning or sharpening. The usual arrangement of cast-brass vertical legs without such a sliding plate must have the base heated and the leg bent out to allow for the manufacture or for the release of the fulcrum, a much more difficult operation. Was this CCD the forerunner of the Troemner, or a later adaption? The presence of the sliding cover suggests the latter.

Fig. 4. A drawing prepared for the forthcoming book by Eric Newman and George Mallis, *Compendium of United States Coin Scales and Counterfeit Coin Detecting Mechanisms*



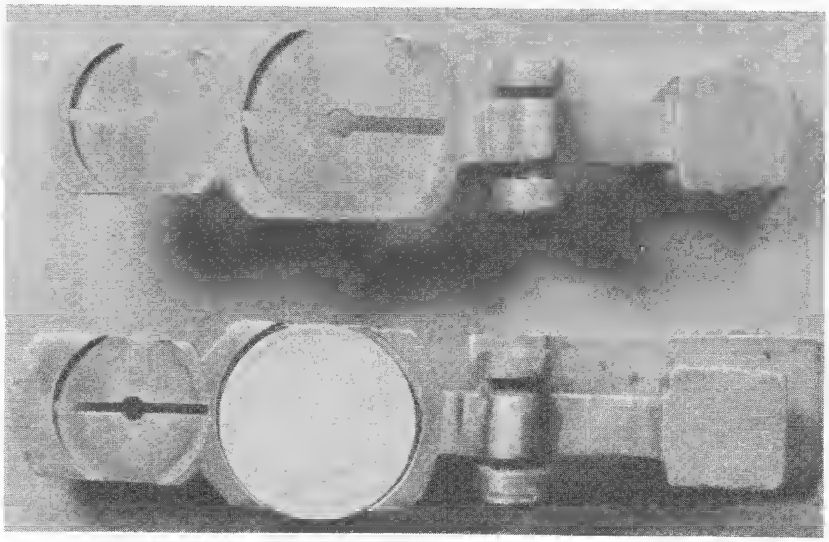


Fig. 5.
Top. An unmarked CCD. The base has a rounded end. The fulcrum pin was inserted, then a dust-cap put over the hole, preventing the pin from shifting. The cap is visible above the fulcrum.

Bottom. A similar CCD by CHAS F SEYMOUR, with his name stamped lightly in a semi-circle and 442 W 46 ST NEW YORK, across the top surface of the poise. The dust-cap is visible at the bottom, below the fulcrum. Note the practical base, which is unlikely to tip.

The third and best known non-patented American CCD is one marked CHARLES F SEYMOUR. 442 W. 46 St., NEW YORK. (Figs. 4 & 5, bottom). Seymour duplicated the unsigned CCD but gave a bigger base with a straight end and added a second sliding cover plate. I believe this cover plate may be unique to these two CCDs. Neither the MEYERS & CO. rocker for gold coins nor the TROEMNER for quarter and half-dollar has it.

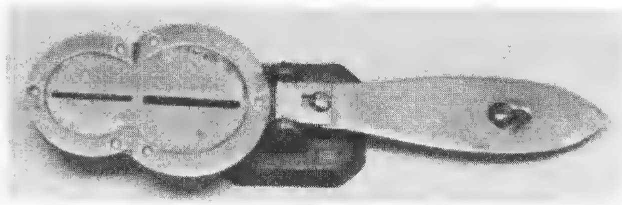
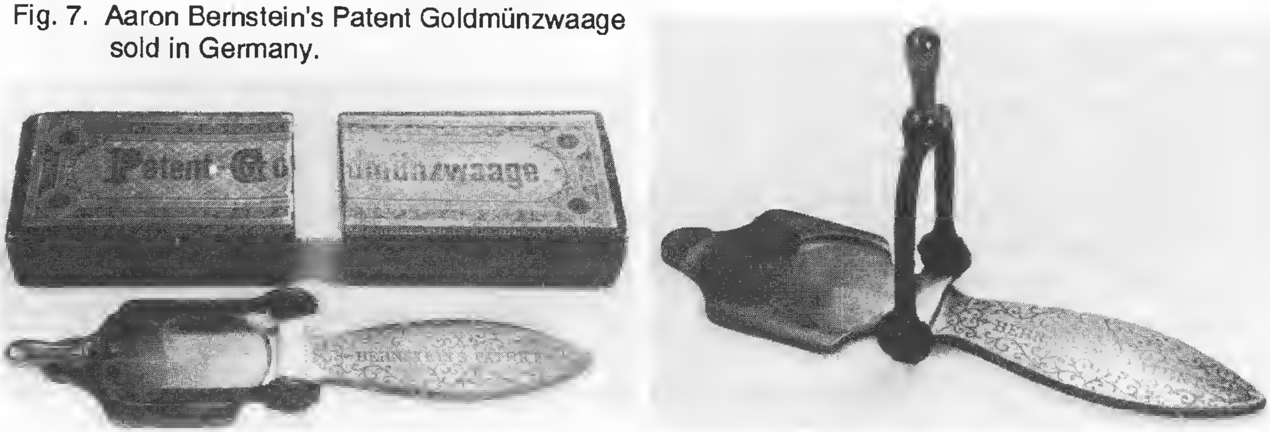


Fig. 6. Unmarked CCD, described below.

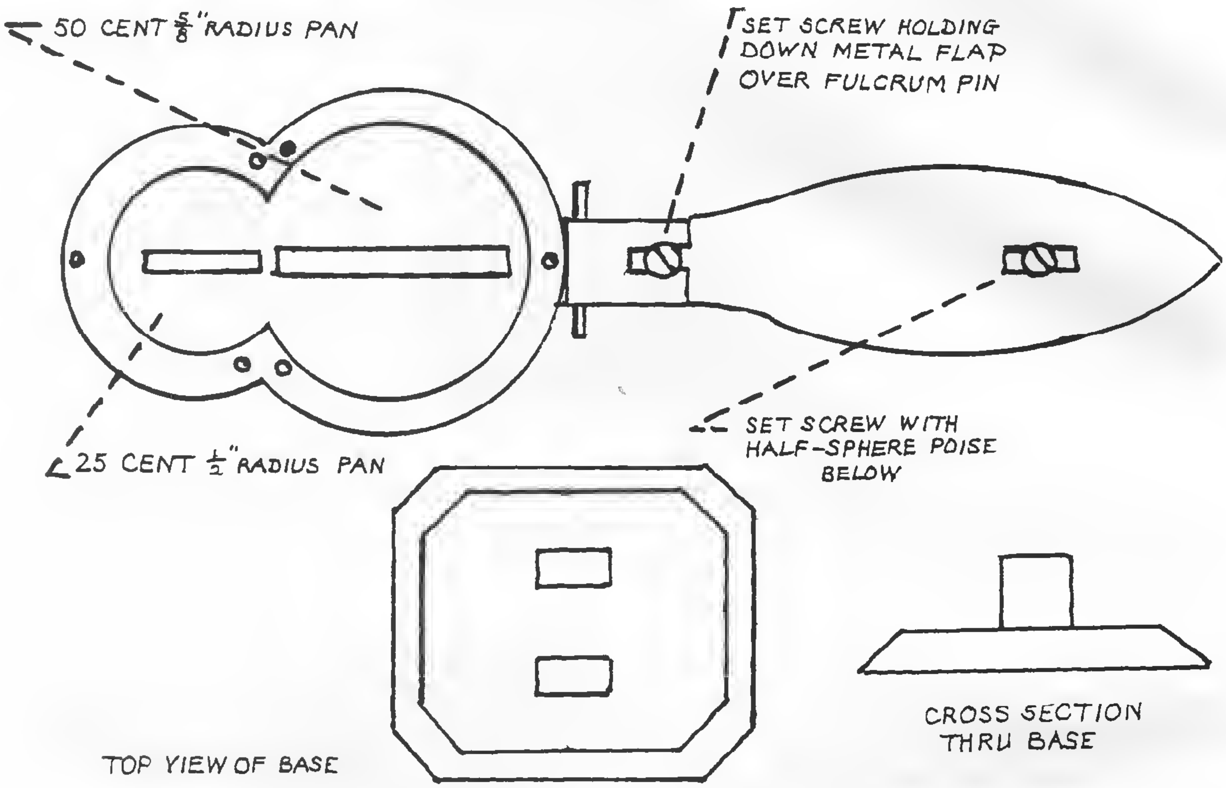
Another unpatented American CCD is shown in Fig. 6. The design is an unusual rocker shape with two intertwining circular pans on a short arm and a gracefully curved longer arm that carries a moveable poise below. The rocker arm is made of a nickel-plated brass strip, 5¾ inches long. The base is cast-iron painted red, with two integrally-cast vertical arms that support the fulcrum. A set-screw holds down a plate that, in its turn, holds down the fulcrum pin.[6] Like the rockers described above, this one is designed to accept the Seated Liberty type quarter and half dollar. The position of the half-spherical counterpoise can be adjusted by loosening the set screw and sliding the poise in either direction. This feature suggests a date of 1853 or later, since the legal weights of those two coins were first changed at that time.[7] When the poise is towards the fulcrum, it balances the coins made after 1853, and when the poise is away from the fulcrum, it balances the coins made before 1853. Coins having the proper diameter and weight will fit

Fig. 7. Aaron Bernstein's Patent Goldmünzwaage sold in Germany.



within the pans and balance the counterweight, and with the correct thickness, will rest vertically in the slot without dropping through and possibly getting lost.

Fig. 8. Drawing taken from Mallis' engineering drawing for the forthcoming book. Full size.



The rocker in figure 6 is very similar to one invented for weighing German gold coins (Fig. 7) by Aaron[8] Bernstein of Berlin, Prussia, (who also took out U.S. Patent No. 183,833 for an Improvement in Coin Counters in 1876, EQM page 842[9]). The German detector is hand-held rather than base-mounted, and has no sliding poise, but the two designs are strikingly similar. While there is no documentation currently known that proves or disproves this contention, the striking similarity of the two basic designs makes the likelihood of copying very tenable. The late Michael Crawforth, founding editor of EQM, suggested that either the U.S. design was made by Bernstein, or his idea was borrowed by someone in the United States. The author's requests of the German Patent Office for documentation on the German device have not yet been answered.[10]

And now, having looked at several CCDs patented but never made, at least in the image of the drawings, and at several more made but never patented, we turn our attention to patents that were apparently issued but whose actual patent records are apparently lost. These very early patents include at least one CCD, and perhaps more:

1. Counterfeits, Check to Detect; J. Perkins, no address given, Mar 19th 1799.
2. Balance; S A Rogers, Geneva, N Y, July 31st 1819.
3. Balance; Benj. Dearborn, Boston, Mass, Mar 24th 1819.
4. Balance; Dearborn's, U West & D Loring, N Y, N Y, Aug. 23rd 1831.
5. Balance; N Griffing; N Y, N Y, April 8th 1835.

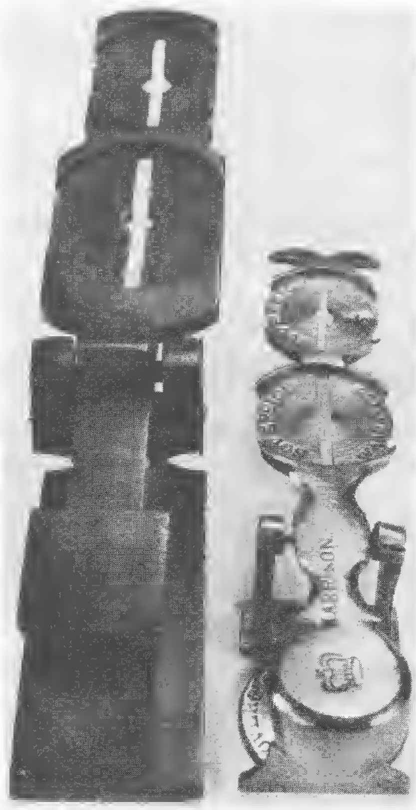
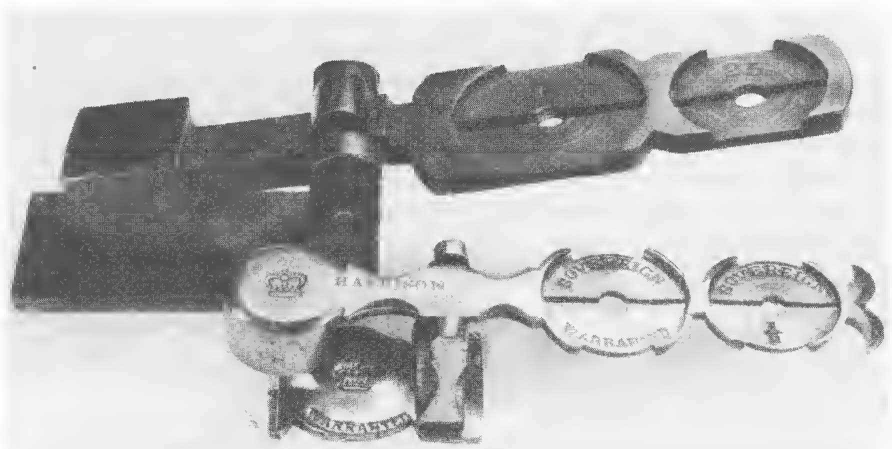


Fig 9. An anonymous American CCD beside a standard English rocker. Both check two coins, the American coins weighing about 6.68 gms and 13.36 gms and the English coins weighing about 3.99 gms and 7.99 gms. Does the American CCD need to be so much more rugged than the English one? The American CCD weighs a massive 193 gms, whereas the English one weighs only 49 gms.

If the year given for the Perkins patent is correct, that CCD predates any other known model by at least 41 years. I have just learned that the Patent Office and some of its depositories now maintain collections of all or most of the patents issued since 1790. Has any reader found copies of these early patents, either in Washington or at one of the eighty Branch Patent and Trademark Depositories? If so, please let me know!

Fig. 10. The American CCD has two blued-steel dust-caps, which must have looked handsome when the brass was bright. Now the brass is tarnished. The English makers applied a saffron-tinted lacquer to their rockers, so they maintain their rather lurid yellowness! The English one is less well-made, so the beam (with its fulcrum-pin already inserted) could be forced down between the pillars, relying on the slight springiness of the brass base to close up and hold the beam in place. Heating was not needed for this process.



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Mallis, A George, American Counterfeit Coin Detectors (series), *EQM,* 786-88, 818-20, 840-42, 875-76, 902-04, 930-32, 962-64, 990-92, 1018-20.

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Notes and References

1 The McNally-Harrison CCD, which could test both gold and silver US coins, was marked variously Fairbanks & Co., Fairbanks Infallible Scale, and also with just the name J T McNally Inventor. Instructions in the Infallible 's box identify W H Harrison as the manager of that company. EQM, 15, 962.

2 For two earlier patents by Maranville, both of which were produced as drawn, see EQM, 818 and 1029, and 761-763.

3 For these five patents, see EQM, 1020 (Robinson), EQM, 841 (Cummings) and EQM, 990 (CCDs by Purnell, Richtman, and Knight).

4 Philadelphia city directories, 1838-1870. EQM, 762 and 764.

5 See endnote 7.

6 This screw is reminiscent of the method used by P J Maul to hold down the fulcrum pin (see EQM, pages 1614-1621).

7 Yeoman, R S, *A Guide Book of United States Coins*, gives the following specifications for Seated Liberty quarter dollars and half-dollars:

Period	Quarter Dollar's Weight	Period	Half Dollar's weight
1838-1853	6.68 gms	1839-1853	13.36 gms
1853-1873	6.22 gms	1853-1873	12.44 gms
1873-1891	6,25 gms	1873-1891	12.50 gms

Composition: 900 parts of silver to 100 parts copper, both coins, constant.
Diameter: quarter-dollars 24.4 mm; half-dollars 30.6 mm, constant.

8 Aaron Bernstein's name was spelled as Aron Bernstein on his U.S. Patent.

9 Aaron Bernstein's 25 international patents on his Apparatus for Sorting Coins are discussed by J Lindner, EQM pages 1947-1955. See also Alex Bernstein & Co., EQM, 1179.

10 An article on this subject is in preparation and will be published in EQM in the near future.

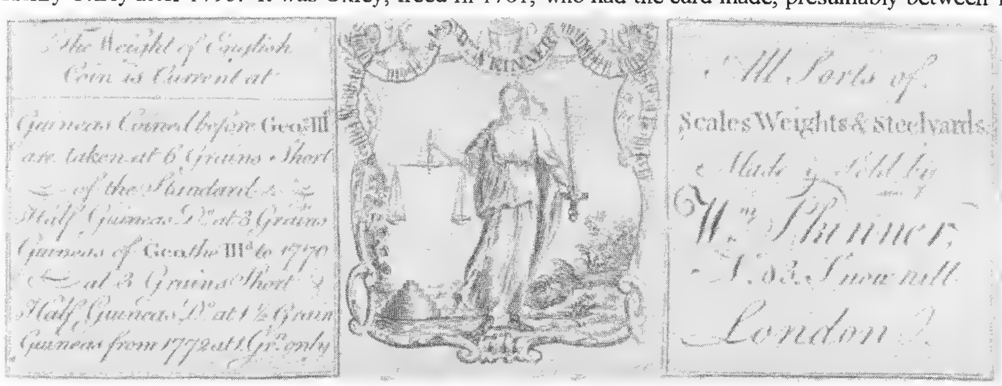
Author's Biography

A George Mallis wrote the 3-volume series *Proposed Standard Designation for Coin Weights* (1990-1992) and co-authored *The Comprehensive Catalogue and Encyclopedia of US Morgan and Peace Silver Dollars*, which was the Numismatic's Literary Guild Book of the Year in 1977 and 1983. Mallis and Eric P Newman are the co-authors of a forthcoming book, *Compendium of United States Coin Scales and Counterfeit Coin Detecting Mechanisms*. More than 400 pages in length and liberally supplied with photographs, US Patent Records and engineering drawings, it is expected to become the definitive work in this field.

He is a Fellow of the American Numismatics Society and a founding member of ISASC. He began his research while principal partner of the architectural and engineering firm in charge of the design and construction of the GSA Building in Alexandria, VA.

Trade Card

This trade card shows the problems of dating using only internal evidence. William Skinner was not freed until after 1788 (the date during his apprenticeship when he was turned over from Robert Vincent to Thomas Williams). Yet he writes of guineas being permitted to pass as currency when 6 grs short (that is, 1 s. short). That standard was officially nullified in 1776 and only guineas with less than 1 gr short were officially currency. (See page 2070). But Skinner *inherited* this card from Henry Oxley after 1793. It was Oxley, freed in 1761, who had the card made, presumably between 1774 and 1776, and Oxley who had moved from 230, Upper Thames St to 83 Snow Hill. The information about guineas was still relevant in 1793, but Skinner had to have the name changed when he took over the business. (Widow Oxley solicited charity from Black-smiths' Co. in 1803, and received 10/6.)



Reaction

to Weighing in the Early 14th Century

BY G NEWALL

On page 1993 of EQM, part way through the article on *Weighing in the Early 14th Century*, it is stated that a Bruges Museum has a few pre-1350 weights, two of which are no more than one grain from a presumed standard. Page 1994 refers to a 1lb weight (Fig. 3) which is but 6 grains less than its original weight. This latter has the appearance of a lead weight but the material of the museum weights is unspecified.

I have no weights of this age but I do have some bronze weights from the reigns of James I to Queen Anne, and of these I weighed 28, noting their excesses or deficiencies.

The weights ranged from 2lb to ½oz, and for all weights the mean deficiency was 3.205%. For the 4oz weights the mean deficiency was 4.723%, the spread being 3.314% to 5.886%. There was no weight in excess.

I have always considered lead to be a much less durable metal than bronze, and that the percentage deficiency of an elderly lead weight would exceed that for an elderly bronze weight. By how much?

Since the answer depends upon the atmospheric conditions, soil conditions, degree of use and of misuse that each individual weight has had to endure, and without knowing its weight when new, we cannot tell.

But I see nothing wrong with guessing that, in general, the deterioration of a lead weight would exceed that of a bronze weight by perhaps 25% or so.

If this were to be pursued, a mean deficiency of 4.723% on a 4 oz bronze weight would translate to a mean deficiency of 5.837% on a 4 oz lead weight. Consider the weight shown in Fig. 2 which weighs 1653.5 grains. This 1653.5 grains, raised by 5.837%, i.e. 1653.5 x 1.05837 would become 1750 grains, four of which are the equivalent of the 7000 grain avoirdupois pound that so many of us know and love.

Then came dim memories of lectures in metallurgy. There was very little on non-ferrous metals but I seem to remember that one of the qualities of lead was that under certain conditions of corrosion its weight could increase. I have no recollection of the conditions required to cause this increase, nor by what amount and in what time.

If this be true however, a 600-year-old lead weight can be assumed to have lost weight by use, cleaning, mis-use and corrosion with the possibility of a gain in weight if subjected to conditions conducive thereto.

It would be most useful if one of our members with about two dozen (24) lead weights of a known standard, and preferably of similar denominations to those mentioned, could weigh them and quote a mean excess or deficiency. This would provide a factor by which we could cnhance or depress a new find of unknown standard to something akin to its original weight, and thus be projected to givc a rough shot at the original standard.

Using the present weight (mass) of any centuries-old weight to a grain or so for claiming compliance with a standard is far beyond what I would accept as credible.

As shown, a plausible manipulation of the numbers readily transforms a weight from one standard to another.

Certainly one of the main requirements in rcscarch of this nature is a brush with elementary statistics which will show the reliability of the results from a given size of sample.

Coins weighed by the Drop BY A D C SIMPSON

Coin scales and weights were produced in great numbers across the British Isles towards the end of the 18th century in a period when the quality of gold coin in circulation had deteriorated sharply and official measures were being taken to control this depreciation and to effect a major recoinage. Under-provision of guineas by the London Mint, coupled with systematic exploitation of different relative exchange rates for gold and silver abroad, led to a progressive shortage of guineas and a flood of imported foreign gold coins which passed as currency in the British Isles, particularly during the boom of trade with Portugal during the mid-18th century. By the 1760s, much of the gold in circulation was elderly Portuguese coin and worn guineas, and the activities of coin clippers and counterfeiters brought the situation to crisis level. This topic has been explored, notably by Michael Crawforth and more recently by Paul and Bente Withers, who have shown the effects of a series of Parliamentary Acts in the 1770s which set minimum weights for current coin and managed a phased withdrawal of demonetised light coin.[1]

The great expansion of scale production at this period represents a response to widespread public anxiety about the risks involved in financial transactions, and it is clear that, for a time, gold coin scales were extensively used. Because the scale manufacturers normally listed the accepted weights on the labels pasted inside scale boxes, and because these weights were often also marked on the weights themselves, these figures (expressed in pennyweights and grains) are very familiar to collectors. Thus the Portuguese moidore, accepted at 27 shillings, had to weigh 6 dwt 22 gr, the Portuguese 8-escudo piece (£3 12 shillings) was 18 dwt 10 gr, whereas British guineas (21 shillings) were normally recorded as 5 dwt 6 gr if coined before 1772 and as 5 dwt 8 gr if coined subsequently.

It was a surprise, therefore, when a coin scale sold by James Lockhart of Glasgow was drawn to my attention by Diana Crawforth-Hitchins which carried the familiar type of weight table but with quite different figures for the coin weights. See Fig. 1. This scale has now been acquired by the National Museums of Scotland.[2]

At first sight the weights appear to be given in drams (presumably avoir drams) and grains, with the Portuguese 8 escudo ('1 Portugal Piece' or Piece of Eight) at '14 drs 23 grs', the moidore at '5 drs 16 grs' and the guinea at '4 drs 9 grs'. If this was indeed the dram, or sixteenth of the avoir ounce, then at its accepted value of 27.35 troy grains, the guinea was only 118½ grains - markedly less than the 128 grains of the Act. Could this be evidence of a totally different rate being applied, either dishonestly or as a consequence of previously unsuspected regulations, perhaps applicable only to Scotland?

In fact, the table's description of the sixteenth of the 8 escudo piece ('sixteenth Portugal Piece') as 27½ grs (rather than 1 dr) shows that this interpretation cannot be correct, and the weights given for the halves, quarters, etc, of the various coins in the table clearly indicates that 1 dr = 30 grs. The confusion has been caused by the use of the conventional abbreviation of a traditional Scots weight term, the 'drop' or 'drap', for the sixteenth of the ounce (in this case the troy ounce of 480 grains), used in preference to the English practice of dividing the troy ounce into 20 pennyweights (dwt or pwt) of 24 grains. The weights given by Lockhart in his table are indeed directly equivalent to those normally encountered and we can therefore say confidently that they are governed by the same legislation: they are merely expressed in terms of different units.

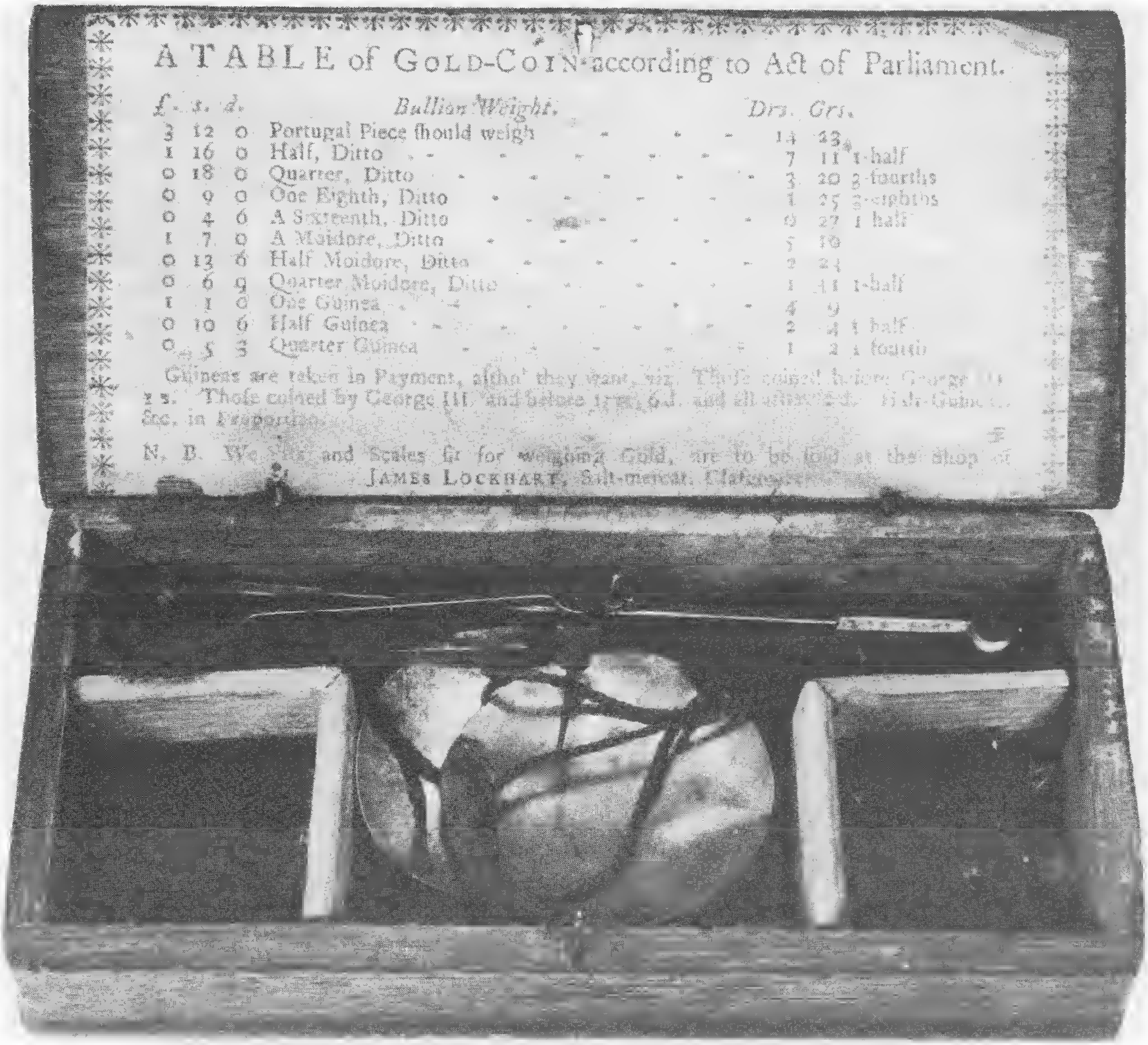


Fig. 1. The stained portion of the label reads: **'Guineas are taken altho' they want, viz. Those coined before George III. 1 s. Those coined by George III and before 1772, 6 d. and all after 2 d. Half-Guineas, &c. in Proportion. N. B. Weights and Scales fit for weighing Gold, are to be sold at the Shop of JAMES LOCKHART, Salt-mercat, Glasgow.'** If the coin 'wanted' (i.e. had lost) more than the quantities mentioned above, then the coin was considered to be bullion only, and was no longer a coin of the realm.

Unfortunately the Lockhart scale no longer has its original weights in the box. This raises the very interesting possibility that the individual weights were also marked in drops and grains in addition to the currency value of the coins. None of these values have been recorded by the Withers in their recent extended work on coin-weights, and none are noted in Sheppard and Musham's earlier account.[3] The label in Lockhart's scale makes no specific claim for his manufacture, but if he had been buying-in his scales and weights and merely adding his own printed label using the locally-familiar units, the likelihood is that the weights would have been produced in Glasgow, and if they were marked with the accepted weights of the coins as well as with their values, then these weights would be expressed in drops rather than pennyweights.

(Alternatively the weights of the individual coins could have been built up from a supplied set of small-denomination drop weights and grain weights.)

Lockhart became a burgess (freeman) of Glasgow in 1757, and he was described as a merchant at the time of his entry into the craft Guild of Hammermen in 1776, when his production of an essay (a pair of silver piercers) confirms that he was considered an operative member.[4] This latter date may be significant. Lockhart's table includes the interim rate for accepting light guineas struck before 1760, which changed hands at one shilling below face value: this rate, equivalent to a weight reduction of 6 grains, officially lasted only from 1773 to 1776, although in practice banks continued to accept such guineas for several years afterwards. (See EQM, 2066). However, the fact that this information is included on the table suggests that it was first printed during this period, so his belated application to join the Hammermen may be linked to a new manufacturing enterprise - such as his production of coin scales.

It is also apparent that Lockhart was pitching his product at a local market, where the drop would be appreciated as the appropriate weight unit. In contrast, the Glasgow instrument maker, John Gardner, who had been senior journeyman for James Watt (of steam engine fame) launched a relatively sophisticated coin scale in 1773 which used pennyweights.[5] (See EQM, 1306.) But this product was aimed at a wider and more discriminating Scottish market, including Edinburgh, where the use of the pennyweight would be expected.[6] Even in northerly Aberdeen the pennyweight was preferred in coin scales, as seen for example in a fine example of 1773 by the Aberdeen goldsmith Benjamin Lumsden, in the National Museum of Scotland.[7] See a similar one, privately owned, in Fig. 2.

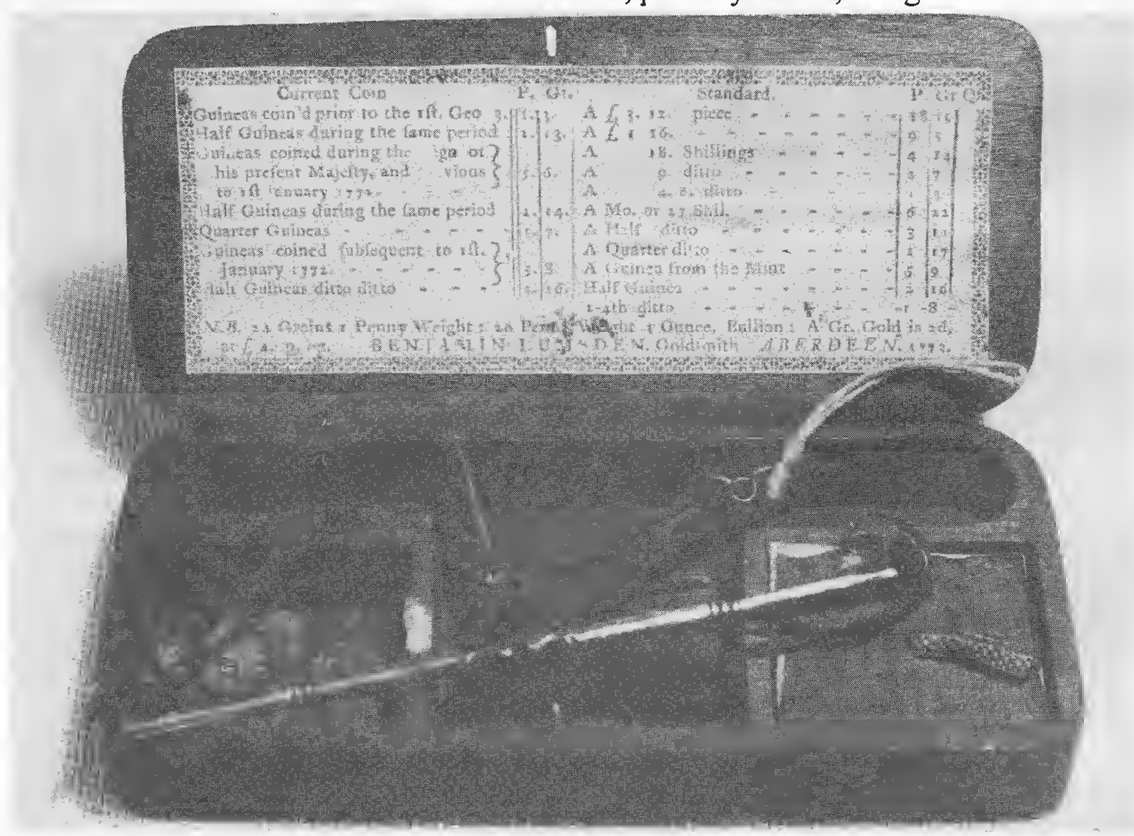


Fig. 2. Coin scale with square pans in a cut–from–solid box. The lower portion reads **'N. B. 24 Grains 1 Penny Weight: 20 Penny Weights 1 Ounce. Bullion: A Gr. Gold is 2d, at £4. p. oz. BENJAMIN LUMSDEN, Goldsmith, *ABERDEEN*, 1773.'** Was Lumsden tactfully reminding his clients of the official system, as they might have been more familiar with drops and grains? W Doniger coll.

Since the drop has made no appearance in the coin weight literature, it is worth saying something about its origins and use. The term is not defined in any Parliamentary assize, and has been encountered in official records only from the early 17th century. By that time, Scottish weight systems operated on multiples of sixteen - 16 ounces to the pound and 16 pounds to the stone - and the drop merely provided the sixteenth part of the ounce. Before this time, it is difficult to find circumstances when this level of precision was recorded, but one example is a payment in the Scottish Mint accounts of 1554 for the purchase of 'five vnce and half ane droip weght of gold'.[8]

The drop was associated with the Scots 'trois' or troy series, which was a mercantile weight which also had bullion functions - being described in the 1560s, for example, as 'the siller [silver] wecht' to distinguish it from the heavier 'trone' weight used for inland trade.[9] When trois weight was first officially defined, in 1426, it was based on the Flemish silver or English troy ounce (480 English troy grains). However, it later became aligned to the slightly smaller Paris ounce (472½ English troy grains), perhaps in the late 15th century and certainly by 1510.

Just as the Paris ounce comprised 576 French grains, the Scottish trois ounce was also 576 (Scots) grains, and so the drop was 36 (Scots) grains. Alexander Hunter, who was associated with the Mint from 1592 as a receiver of bullion, published a quasi-official account of Scottish weights and measures in 1624.[10] In this he described the drop as 36 grains and also recorded the difference between the 12-ounce English troy pound and 12 Scots trois ounces as 3 drops and 21 grains; the Scottish Mint ounce, or more correctly the bullion receipt ounce, was therefore about 471¼ English troy grains. The relationship between the two coinage ounces became a matter of particular concern to the monarch in 1603 when James VI of Scotland also became James I of England. Hunter's figure is derived from an accurate comparison made in 1604 by the eminent Edinburgh mathematician John Napier, the inventor of logarithms, but his tabulation is couched in terms of the specialised weights used for coinage, in which the ounce is divided into 24 deniers, each of 24 grains, with the grains further divided in factors of 24 into primes, seconds, etc.[11] Silver fineness was also computed in deniers. Although the weight of silver and gold coins continued to be expressed in deniers up to the final issues in the 1690s, the weights of copper coin were given in drops from the 1640s and comparisons made at the Mint at the same time between merchant forms of trois, such as the Flemish 'fleur-de-lis' weight, were also expressed in drops.[12]

- 144×4

In 1707, Scots weight was (in theory at least) replaced by English weight under the terms of the Act of Union. Officially, bullion weighing was now to be conducted in English troy ounces and pennyweights. However, old practices die hard: the advocate John Swinton tabulated the troy units in his 1779 analysis of English and Scottish metrology, adding in a note; 'In Scotland, Gold and Silver are weighed by the above [troy] ounce and pound; but the ounce is divided into 16 drops, and the drop into 30 [troy] grains'.[13]

Swinton also listed the drop as the sixteenth of the ounce of the final form of the Scots trois weight (then known as 'troye'), where he gave it as 29.75 grains. The larger Scottish market pound, or 'trone' pound, was one-and-a-quarter trois pounds and so could be considered either as comprising 16 trone ounces or 20 trois ounces.[14] Confusingly, Swinton tabulated it in terms of trois ounces and drops, and it was probably this that caused early 19th century commentators such as George Buchanan to claim the existence of a trone drop, as a sixteenth of the trone ounce.[15] Although this has also been followed by Ronald Zupko, it is clear that the drop was only ever appropriate to the Scots troy system.[16]

The author would be delighted to hear of any coin weights specified in drops which may be known to ISASC members. The author can be reached at the National Museums of Scotland, Chambers Street, Edinburgh, EH1 1JF, Scotland.

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2 Inv. NMS T.1996.146.

3 Sheppard, T, & Musham, J F, *Money Scales and Weights*, London, 1923. Reprint edition, London, 1975.

4 Lumsden, H, & Henderson Aitken, P, *History of the Hammermen of Glasgow*, Paisley, 1915, 294.

5 Bryden, D J, John Gardner's Coin Scale, *Equilibrium*, 1990, no. 1, 1303-1311. For Gardner, see T N Clarke, A D Morrison-Low and A D C Simpson, *Brass & Glass*, Edinburgh, 1989, 164-179.

6 At least one example is known which was purchased by an Edinburgh client: NMS correspondence.

7 Inv. NMS T. 1978. 90.

8 Cochran-Patrick, R W, *Records of the Coinage of Scotland*, 2 vols, Edinburgh, 1876, 1, 62.

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11 Cochrane-Patrick, I, lxxxiv.

The first printed listing of the equivalent English grain fractions appeared in the same year; Grierson, P, Computational Fractions of the Grain: Mites, Droits, Periods and Blanks, *British Numismatic Journal, 52*, 1982, 181-186.

12 Cochrane-Patrick, II, 67; I, lxxx-lxxxi.

13 [Swinton, John], *A Proposal for Uniformity of Weights and Measures in Scotland*, Edinburgh, 1779, 36.

14 Simpson, A D C, Scots Trone Weight: Preliminary Observations on the Origins of Scotland's Early Market Weights, *Northern Studies*, 29, 1992, 62-81.

15 Buchanan, G, *Tables for converting the Weights and Measures hitherto in use in Great Britain into those of the Imperial Standards*, Edinburgh, 1829, 34. Buchanan's value of 35.588 grains for the (Edinburgh) trone drop was based on a faulty analysis of the surviving standards.

16 Zupko, R E, The Weights and Measures of Scotland before the Union, *Scottish Historical Review*, 56, 1977, 119-145, p 127.

Author's Biography

Dr. Allen Simpson is a curator in the History of Science Section of the National Museums of Scotland in Edinburgh where he is a colleague of Alison Morrison-Low who has also written in EQM. He is currently working with Professor R D Connor of the University of Manitoba on the completion of an administrative history of Scottish metrology. This is to be published as *The Weights and Measures of Scotland*, and it is eagerly awaited by EQM's editor and by other ISASC members. Its scope will be much wider than the working title suggests because it will also provide an important revision of parts of Robin Connor's 1987 volume *The Weights and Measures of England*; newly assessed documentary material has allowed them to develop a very different view of early English weights and measures.

One of Allen Simpson's responsibilities at NMS is the development of the metrology collection, and he has agreed to contribute to EQM occasional notes like the present one to discuss interesting new acquisitions.

Domestic!

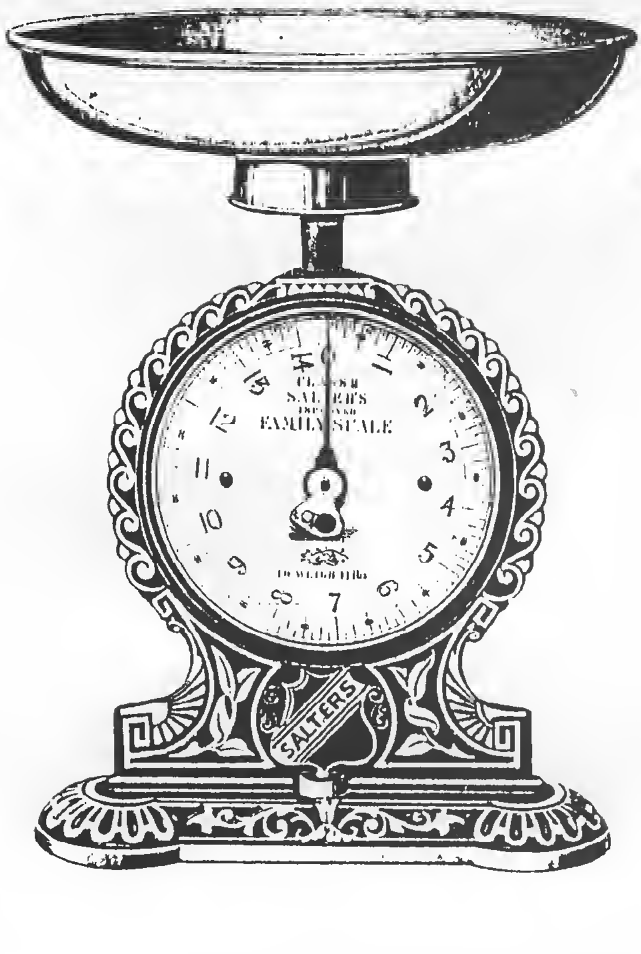
By J KNIGHTS

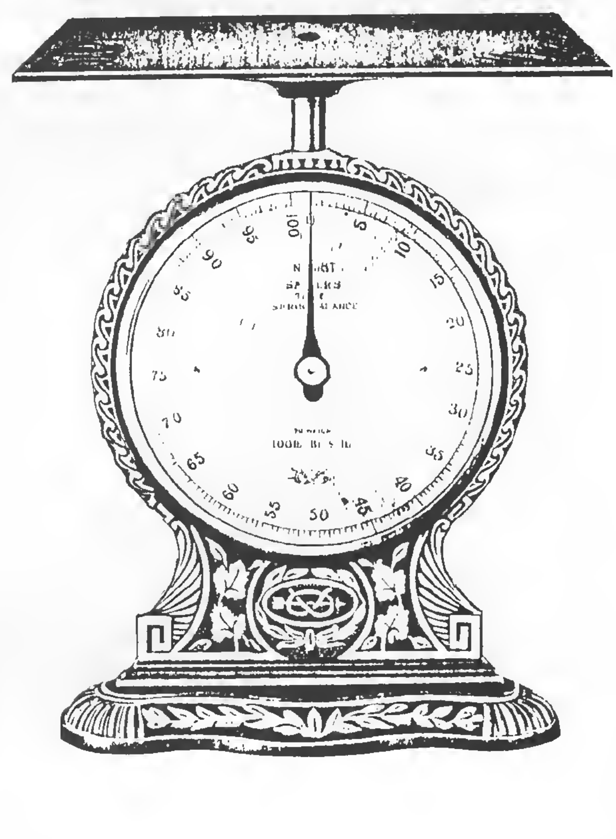
The word "domestic" is one of those intrinsically innocuous terms that, nonetheless, carries a variety of not altogether favourable connotations when used in certain specialist fields.

To the British policemen, for instance, the word connotes a violent occurrence on private property, in which the protagonists are related by marriage etc. The policeman also knows that official intervention in such a dispute is likely to unite the erstwhile combatants against the well-intentioned peacemaker and thus regards this type of incident as the proverbial "poisoned chalice".

To the inspector of weights and measures the term carried a similarly unsavoury, if slightly less violent association. It was the word used to describe any piece of non-trade equipment found to be in use in a trade environment. It might have been a typical rough-cast kitchen weight without the requisite adjusting hole, or worse still, a nasty little counter-machine with a base of flimsy mild-steel instead of cast-iron and a screw-threaded balance poise sticking out from under the weights pan. Whatever the nature of the equipment, its discovery in this alien ambit was as welcome as the finding of a scorpion in the biscuit barrel. It was not merely the fact that the equipment was unstamped that caused offence. Proper equipment could, in certain circumstances, escape the verification process and find its way into use. Provided such apparatus was not found to be also false or unjust, its discovery would not normally attract the special degree of obloquy which was heaped upon the unfortunate domestic.

Fig. 1. G Salter & Co, 1912 catalogue. Which was the domestic? The left-hand one was a Family balance, no. 45. The right-hand one was a Parcels balance, no. 58T (T signifying that it was suitable for trade use), and it was supplied plugged ready for stamping by an inspector.





Equipment intended for trade use has to meet exacting standards of accuracy and be manufactured to a high level of construction. In situations where equipment is to be used for an uncontrolled purpose, none of these requirements apply and the standard of manufacture is solely a matter for the maker. As a result, some of the resulting apparatus is of a lamentably low quality, with none of the attributes associated with good practice. It was then this opinion that the equipment in question was of a lower order that gave rise to the inspector's revulsion.

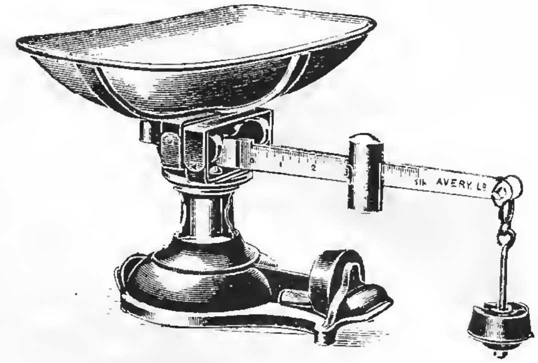


Fig. 2. W & T Avery Ltd, 1912 catalogue. Lever Counter Scale, not for Trade Use in England (sic). Supplied with a capacity between 20 lb and 100 lb. Many a shop-keeper must have wondered why the scale that was permitted in his youth was banned after 1907.

Long before it ever occurred to me to collect weighing equipment, therefore, I had been inculcated with this model of good practice. I had indeed, during the course of training, learned to draw and describe all manner of trade equipment and the various components of which they are made. I knew all about swan necks, box ends, face lines, agate boxes, leg steels, scale beams, beam scales, dutch ends, friction nibs, centre forks, sliders, vibrators, top weight, gallows, front stays, etc. etc., and I was aware of the criteria that favoured one form of machine or component over another.

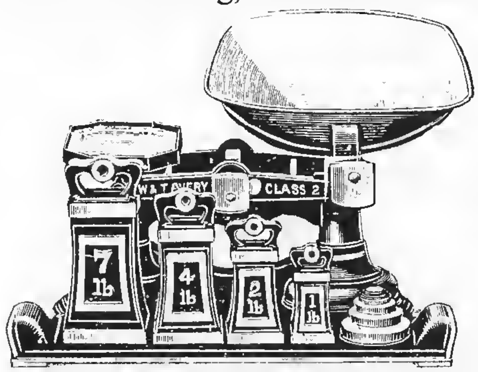


Fig. 3. W & T Avery Ltd, 1912, no. 502. For domestic use, with hardened Steel Knife-edges and Bearings and Brass Caps over Bearings, neatly Japanned and Gilt at 26/-. Also supplied under the name of J Garland & Co. as Second Quality, unsuitable for trade purposes in England under the W & M Act of 1889, at 15/6.

Upon moving into collecting (or hoarding, as certain unkind people have been moved to describe my activities) it was naturally trade equipment that attracted my interest. I soon discovered, of course, that fellow 'librologists', 'metrolophiles', 'basculogues' (what is the appropriate noun? Scope for a competition perhaps) were attracted by a wholly different area of apparatus.

Collectors in general acquire on the basis of appearance. Whether it is porcelain, silver, furniture or some other more arcane area of acquisition, it is ultimately the visual appeal that singles out one item over another. True, age, style, manufacturer etc. are important, but only in so far as they delineate that which is most pleasing to the eye.

As an "innards" man myself, the appearance of a scale or weight was of secondary importance when set against the principles of manufacture involved, the uniqueness of component design and its place in metrological history.

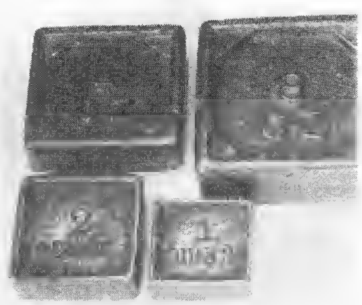


Fig. 4. Rough-cast brass weights for kitchen use. No adjustment hole beneath.

When confronted with the kinds of equipment so beloved of many scale collectors, therefore, I found that my own motivations were clearly not those of others. Where some may look at a parcel scale of particularly desirable provenance and marvel at the elegance of the mahogany base and the classical sweep of the brass fittings, my own thoughts would instead turn to wondering why the man could not

have contrived to incorporate a proper stay that kept a uniform length whether the system was in state of tension or compression. It would then occur to me that such a consideration was of minor importance given that the sensitivity of the scale was so poor that any error induced by stay inequality would be scarcely noticeable.

In short, the old snobbery about "domestics" came welling to the surface whenever I beheld so much of that which others found so desirable.

This pedantry is, I realise, a curse from heaven that keeps me from much innocent enjoyment, but I think that I am now stuck with it for life.

Fig. 5. Day & Millward Ltd, 1912, Cheap Counter Machine, for Domestic and Export only. Fitted with Iron Centres and Bearings and made to vibrate, cost 13/6. Also supplied by W & T Avery Ltd in 1912, and still supplied by Fairbanks Co (Europe) Ltd in 1925. Probably bought in by all three companies so that they could offer a full range, from top-quality to cheapest.

Fig. 6.
Rough-cast iron weights without adjustment holes beneath.

The left-hand set goes from 2 o up to 1 L.

The right-hand set goes from ¼ oz. to 2 oz inside the round box, the lid forms the ¼ lb, the base of the box forms the ½ lb, and two large weights of conventional design under the box are for 1 lb and 2 lb.

I'm afraid the best I can hope for, when faced with some solid gold desk accoutrement, masquerading as a letter balance, whose mechanical qualities are such that it clearly would not turn to half a brick, let alone an item of first class correspondence, is to resort to the phrase of Pierre Francois Joseph Bosquet, suitable adapted of course. C'est manifique, mais ce n'est pas ...

Author's biography
John Knights was trained as an Inspector of Weights and Measures, but, with all the new legislation, he spends most of his time dealing with other consumer problems nowadays.

Note from the editor:
An example of a sturdy scale that was 'domestic' in Britain was the Union scale, discussed in EQM, pages 1803-15, 1835-40,1877 and 1878. Accelerating machines were 'domestic' after 1907, as shown in EQM, page 1637.

Grandfather's Standards

BY B READ

***Frederick Stanley Read** (1866-1924) was employed by the Standards Department of the Board of Trade from 1 April 1890 to 1921. At first he was described as a "Mechanic" in department records but from about 1907 he was "Assizer". One of his main duties was the supervision of the standard weights and measures which were then housed in an ancient building at Westminster known as The Jewel Tower. In the following article his grandson records what he knows about F S Read and his work.*

For hundreds of years the responsibility for maintaining and ensuring the application of English standards of weight, length and capacity was a function of the Exchequer - the same department which looked after the public pursc. In 1866 the Standards Act transferred this responsibility to the Board of Trade. A house erected in 1764 at Old Palace Yard, on the opposite side of the street from the Houses of Parliament, became the offices of a new official - the Warden of the Standards.

This part of Westminster was, until about 1512, the place where kings of England resided. One of the only remnants of their ancient palace remaining today is a tower built in 1366 (the builders' accounts are on a parchment roll preserved in the Public Records Officc) for thcir jewels and regalia. The Jewel Tower, as it is still known, is a three-storey stone building with stone walls about five feet thick. Because of the great bulk of this building it was regarded in 1868 as *very favourable for standards operations, being free from vibration and not liable to sudden fluctuations of temperature.*

My grandfather first came to the Standards Department at Old Palace Yard on 1st April 1890. Since leaving school, aged 14, in 1880 he had been employed in Charlton in south-east London by Troughton and Simms, well-known makers of mathematical instruments. He had had only an elementary education but during the 1880s had studied mathematics and physics at what was then known as "night-school" or what we would now call evening-classes.

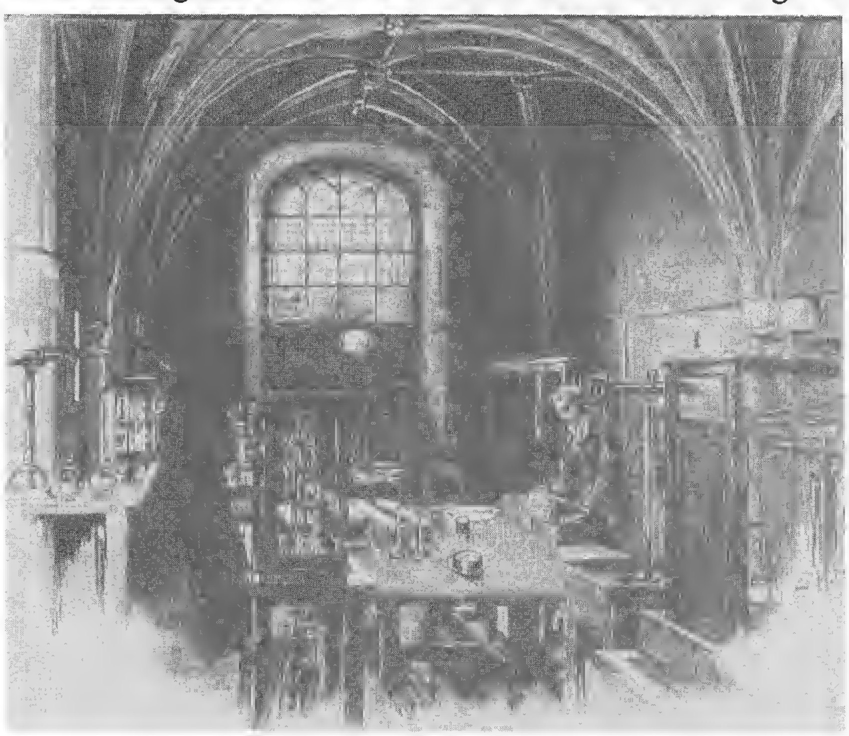


Fig. 1. Engraving done for H J Chaney's book published in 1897, of the basement of the Jewel Tower, used as a balance room. Could this be a picture of Frederick Stanley Read at work?

The telescope on the left-hand edge of the shelf was to be used by the Assizer when he needed to read graduated charts from a distance.

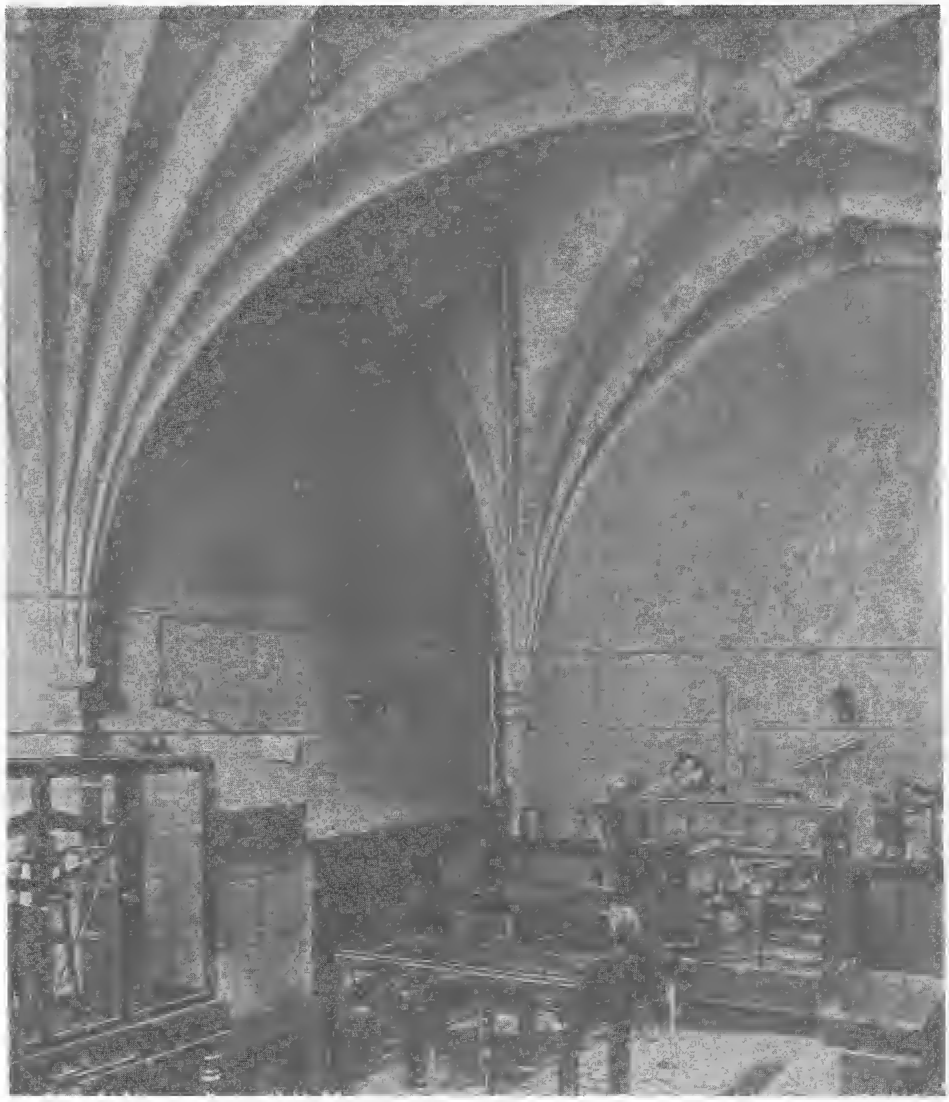


Fig. 2. The balance room seen from the opposite end, showing clearly the design of fan -vaulting that was recently invented in 1366, yet was so well-engineered that it has withstood the pressures of the building above, and the shaking by bombs, for over 600 years.

The Superintendent in charge of the Standards Department when my grandfather was appointed, and throughout the 1890s, was H J Chaney, well-known in his day as the author of *Our Weights and Measures.*[1] From what I have seen of my grandfather's work, I feel confident that he was closely involved in the preparation of this book. However, Chaney makes no acknowledgement on the title page or in the preface of the fact that he was the civil servant superintending the Standards Office nor does he acknowledge any help he might have had with research.

The Weights and Measures Act, 1889, required for the first time that weights and measures inspectors have a certificate of qualification. This was a lucky break for F S Read because with his practical knowledge and his energetic and extrovert personality he was given the job of conducting the practical part of the examination for all candidates. It soon became necessary for him to travel at least once a year to various centres where the examinations were held - Edinburgh, Manchester, Dublin, Birmingham ... Within a few years every weights and measures inspector in the country had passed through his hands. He was invited on several occasions to read papers at the annual meeting of the Incorporated Society of Weights and Measures Inspectors.

In the official language of the time, the main business of the Standards Department of the Board of Trade was the custody of the imperial standards and their periodical verification. They also had to verify the equipment used by the weights and measures inspectors employed by local authorities as well as those of *India, all British Colonies and Dependencies.* A statement issued

in 1907 added *Foreign governments, including the U S A and Russia, come to us for the rectification of their standards.*[2]

When I was a child in the 1930s I remember being shown a large framed picture of the bearded Russian scientist Mendeleyev, and being told that he had been a friend of grandfather's. As there were conflicting family stories about the origin of this picture, I decided recently to check at the Public Records Office for any hard facts. What I found indicates that gifts were given to the staff of the Standards office by the Russian government in 1895 and that the great Mendeleyev did go to Old Palace Yard in 1894.

The story began on 25 April 1894, when the Russian Ambassador in London wrote to the Foreign Office requesting that *Facilities may be afforded to two Russian officials who are coming to England on business connected with weights and measures.* Mendeleyev had recently been appointed Superintendent of Weights and Measures by the Russian government.[3] The request eventually filtered down to Mr. H J Chaney, who replied that he *would be happy to grant to Professor Mendeleyev*[4] *and Mr. Blumbach every facility.* In an internal note to his clerk about the visit he wrote, "Professor M is somewhat infirm."

Apart from technical reports giving details of the comparisons of British and Russian weights and measures, no account seems to have survived of the meetings which took place between the British officials and the two Russians, but the P R O does have the original of a letter written in English at St. Petersburg on 2 December 1895 and signed by the Minister of Finance. This is addressed to Mr. Courtenay Boyle, Permanent Secretary of the Board of Trade:-

Sir, The renewal of the fundamental standards of Weights & measures in the Russian Empire is being carried out with a view to establishing their uniformity. For this purpose, Professor Mendeleev [sic], Director of the Central Standard Department, and Mr. Blumbach, his assistant, were obliged to compare the new Russian standards with those of Great Britain. The comparison has now been completed, owing to the readiness which Your Excellence [sic] has

Fig. 3. The framed picture of Professor D I Mendeleyev above the fire-place at the home of F S Read's eldest son, Conrad, c. 1940. It is now owned by another relation in Australia.

evinced in allowing the above mentioned persons to carry out the said complex operations in the Standards Department, over which you preside. The regard which you have shewn to the interest of the renewal of standards undertaken by Russia, obliges me to express to you the deepest gratitude, while bearing in mind that the exact agreement of the weights and measures of the two Empires may be of importance in their mutual trade relations.

At the same time, I have the honour to inform Your Excellency that, upon my report, HIS IMPERIAL MAJESTY was pleased to award to Mr. Chaney.......and to the four employees of the Standards Department, as a recognition of the co-operation afforded by them gifts which have been transmitted through the Imperial Russian Embassy.

On the same day the Russian Minister of Finance also wrote to Chaney, telling him that:-

HIS IMPERIAL MAJESTY, NIKOLAI ALEXANDROVICH, EMPEROR of All the Russias presents you with a box containing articles in silver & enamel, as a mark of recognition for the ready co-operation, afforded by you to the persons sent to compare the Russian standards with those of Great Britain; and has assigned the four employees....viz.: Messrs Stansfield, Office Keeper, Read, Chief Mechanic, Francis, Assistant Mechanic, and Medden, Messenger, special rewards, which will be handed to them through the Imperial Russian Embassy.

Of course public servants are cautious of accepting any kind of reward from outsiders for their services and Chaney immediately wrote a personal note to his superior officer in which he begged *to express the hope that I may be allowed to have the honour of accepting* the gifts.

In due course, permission was given. The large framed engraving of Mendeleyev's portrait may have been one of those gifts or it may have been a personal gift from Blumbach for it is inscribed

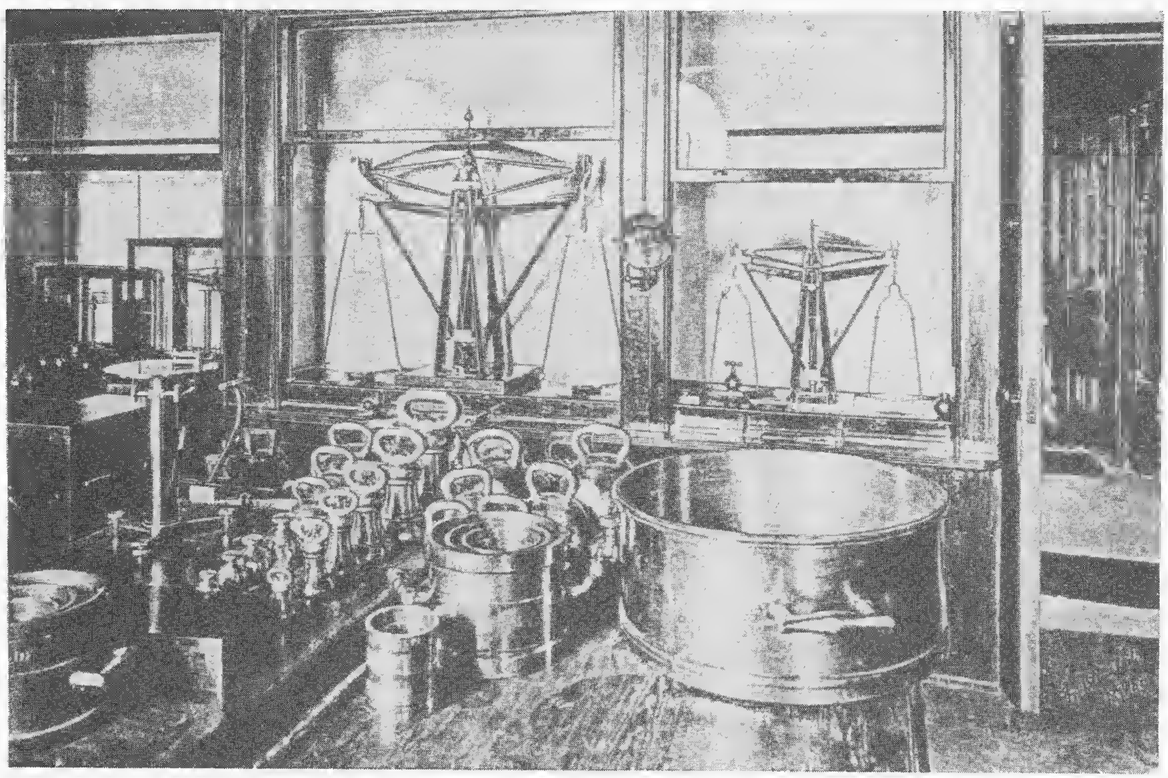


Fig. 4. One of the photographs taken by F Blumbach in 1894/95. The photograph was used in Chaney's book. It shows the Inspector's local standard weights and measures.

"To my friend F Stanley Read in recognition of the kind assistance rendered during the reconstruction of the Imperial Russian Standard of Length in the years 1894 and 1895 - F Blumbach." This impressive picture has been passed down to various members of the family and it now hangs over a Read mantelpiece in Australia.

Professor Mendeleyev died in 1907 and it is unlikely that he came to London again after his visit in 1894 but Mr. (later Dr.) Blumbach was a fairly frequent visitor to Old Palace Yard and is mentioned in unpublished autobiographies written in the 1930s by two of the children of F S Read. His son, Stanley Read, born at Old Palace Yard in 1907, who described his father as "a big man, always smiling and kind, usually pipe-smoking...." remembered that there were frequent dinner parties at Old Palace Yard. Guests who remained in his memory were, in addition to Blumbach, Mr. Francis of Troughton and Simms, and Mr. Elphick of Avery & Co, and Barrett.

It is unfortunate that my grandfather died in office at the early age of 58. As far as I know, he did not leave any written reminiscences about his life. From a few scrappy notes and pictures I have tried to piece together something about his work and the Standards Office of his day. In one note he describes his office as "furnished with wonderful machines and apparatus of the utmost perfection." See the list below in figure 5.

Fig. 5. *List of Balances and other Apparatus for the Comparison of Standard Weights.*

18–21. A set of four balances with steel beams and box ends, constructed in 1825, by Messrs. De Grave and Co., and used until 1870 for the comparison of local standard weights, viz.:-
Balance (A) to weigh from 56lbs. to 14lbs., to turn with an additional load of 3 grains.
Balance (B) to weigh from 7lbs. to 2lbs., to turn with 1 grain.
Balance (C) to weigh 1lb. to 1oz., to turn with 0.1 grain.
Balance (D) to weigh from 1oz. to 1 grain, to turn with 0.05 grain.
22–25. A set of four new balances with beams of bronze (Baily's metal) having steel knife-edges with agate bearings, and all the modern improvements, made by Messrs. De Grave and Co., 1870, for the comparison of local standard weights, and to be substituted for the old balances, viz:-
Balance (E) to weigh 56lbs. to 14lbs., to turn with 1 grain.
Balance (F) to weigh 7lbs. to 2lbs., to turn with 0.5 grain.
Balance (G) to weigh 1lb. to 1oz., to turn with 0.05 grain.
Balance (H) to weigh 1oz. to 1 grain, to turn with 0.01 grain.
26–31. A set of six balances of the best construction, each with gun-metal beams, steel knife-edges, and agate planes, for comparing primary standard weights, as well as measures of capacity by the weight of distilled water contained in them; (No. 1 to 4 made by Messrs. Ladd and Oertling, and No. 5 and 6 by Mr. Oertling,) viz.:-
No. 1. to weigh 56lbs. to 14lbs., to turn with 0.2 grain.
No. 2. to weigh 10lbs. to 7lbs., to turn with 0.05 grain.
No. 3. to weigh 1lb. to 2oz., to turn with 0.01 grain.
No. 4. to weigh 1oz. to 1 grain, to turn with 0.005 grain.
No. 5. to weigh 1 kilgram or 2 kilog., to turn with 0.001 grain, 0.01 grain, or 0.6 milligram.
No. 6. to weigh 30 grains to 0.01 grain, to turn with 0.0002 grain.
32. A balance to weigh a standard pound or kilogram in each pan, made by Barrow, to turn with 0.01 grain when loaded, fitted with two microscopes for reading the Index scales, and used by Professor Miller in his numerous observations for the restoration of the Imperial pound and its copies: with a mahogany case in which it can be packed for travelling.
33. Capt. Kater's large balance with mahogany beam, for weighing a standard bushel, and the larger measures of capacity, when filled with water; to turn with a grain with 300lbs. in each pan. Made by Mr. Bate, 1825, and reconstructed by Messrs. Ladd and Oertling in 1867.
34. Professor Hassler's balance, to turn with 4 grains with 56lbs. in each pan, with brass beam and steel supporting pivots and bearings, to weigh from 56lbs. to 7lbs.; presented by the American Government in 1843.
Each of these balances (no. 18 to 33) stands in a plate glass case upon a firm support.
35. A vacuum balance for comparison of standard weights up to 1 kilogram, now being constructed by Mr. Oertling. The whole balance is placed in an air-tight case, from which the air can as far as possible be exhausted; the pressure of the rarefied air being measured by a manometer connected with the balance case. There are contrivances, suggested by Professor Miller, for changing the weights and pans, without opening the case or disturbing the vacuum..........

The basement of the Jewel Tower held the comparator chamber where the standard yard was kept. For determining the weight of the imperial pound the law required a standard weight constructed of platinum in the form of a cylinder nearly 1.35" in height and 1.1" in diameter. Around this there was a groove into which an ivory fork could be inserted for lifting the weight. This was kept in the Jewel Tower. The balances used for testing were also kept in the Tower. Grandfather describes the room as "almost completely free from vibrations and not liable to sudden fluctuations of temperature." All comparisons had to be made at a temperature of 62°F (16.667°C.) Any sudden change or any radiation of heat from the observer had to be avoided when the fine balances were in use. The operator therefore sat many feet away from the machine and manipulated the balance from a distance.

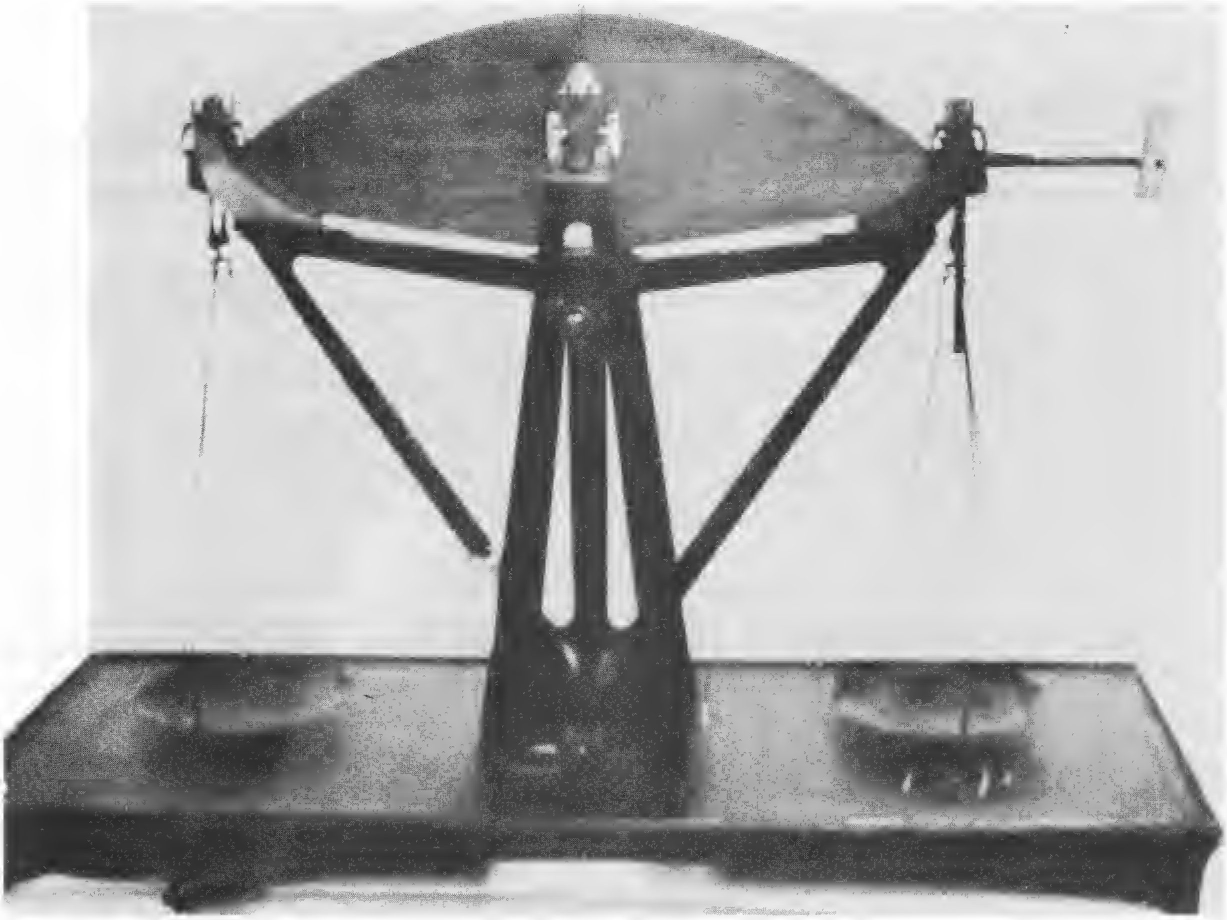


Fig. 6. This is a second balance designed by Captain Henry Kater, having a 48" mahogany beam. It is now in the Science Museum, London. The larger one built by R B Bate, and restored by Ladd and Oertling has a beam 70" long, 22" deep and 2¼" thick and is in the Museum of London.

Grandfather was proud of the extreme delicacy and accuracy of the machines and balances in his care. One would show any difference between two standard pounds under comparison within one ten-thousandth of a grain. An old balance was designed in about 1825[5] by the eminent scientist Captain Kater, FRS, to ascertain the weight of water contained in a bushel (8 gallons or 36.4 litres). See Fig. 6. Kater's problem had been to make a balance which was strong enough to carry a load of 300lb in each pan and yet be sensitive enough to detect a difference of one grain.[6] After numerous experiments he decided that wood gave the best result and he therefore had the beam made of mahogany fitted with steel knife edges and bearings. In 1910 grandfather noted that the balance was so exact that even the weight of a postage stamp would be apparent on a load of 200 lb.[7]

Ask a London taxi driver to take you to the Jewel Tower and he'll probably think that you want to go to the Tower of London. In fact the Jewel Tower is in Westminster, opposite the entrance to the Houses of Parliament. It is at present under the care of English Heritage and contains a small exhibition on the history of the British Parliament. However, on the top floor there is a small notice mentioning that the Tower was a "testing centre for the Board of Trade's Standards Department" from 1869-1938. A display cabinet contains a set of eleven grain weights from 10 to 4,000 grains and a Troy pound of 1824.[8]

Notes and References

1 Chaney, H J, *Our Weights and Measures*, Eyre & Spottiswoode, 1897.

2 Ruding, Rev. R, Annals of the Coinage of Great Britain, 1840. The connections with Russia were of long-standing. As early as about 1608 'the King [James I] sent Walter Basbee, assay master to Goldsmiths' Hall,

to the emperor of Russia, for the purpose of making for him a standard of gold and silver in his mint, equivalent to that of the Tower of London; which shows the high estimation in which that standard was held upon the continent'.

3 Professor Mendeleyev had already co-operated with the Standards Department, in that he had passed to them, probably in 1876, a design for a short-arm balance that could be supplied by the manufacturer, L Oertling, either as an ordinary precision balance or as a vacuum balance.
Chisholm, H W, *Weighing and Measuring and Standards of Measure and Weight,* London, MacMillan & Co, 1877, pages 143-145.

4 The name is spelled variously. The author's spelling conforms most nearly with the pronunciation.

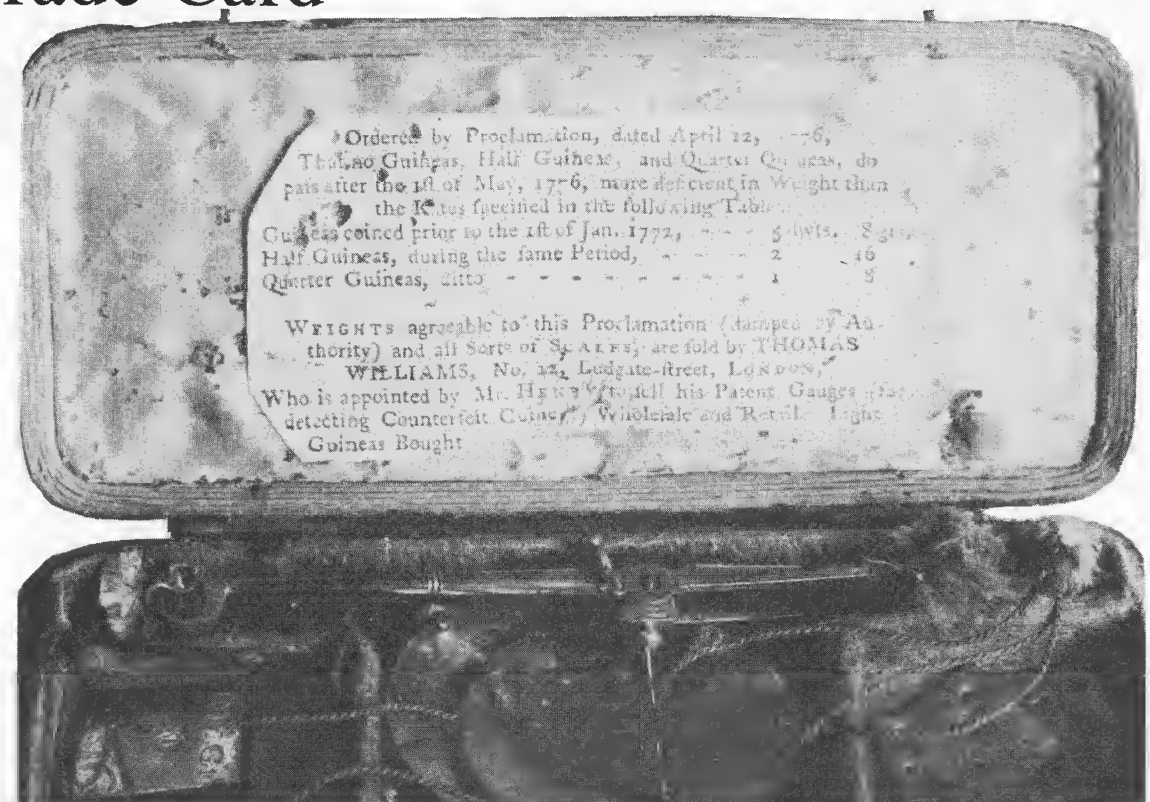
5 *Philosophical Transactions, 1826 and 1856-7.* Details of Kater's design.
Buchanan, P D, Unpublished thesis, 1982, *Quantitative Measurement and the Design of the Chemical Balance 1750-1900.* We are indebted to Dr. Buchanan for supplying the slide taken by J Horsley, Fig. 6.

6 Chisholm, H W, *Weighing and Measuring and Standards of Measure and Weight*, London, MacMillan & Co, 1877. See pages 139-143 for discussion of Kater's contributions to the science of weighing accurately.
Connor, R D, The Weights and Measures of England, London, HMSO, 1987, 258. This gives a concise description of the beam and of Kater's experiments.

7 *Standards Commission 5th Report 1871*, appendix XIX, II, 33. 'Made by Mr. Bate, 1825, and reconstructed by Messrs. Ladd & Oertling in 1867............[This balance] stands in a plate glass case upon a firm support'.

8 The Jewel Tower is open to the public, admission £1.50. Telephone 0171 973 3479 for times of opening.

Trade Card



This trade card shows the dangers of taking the printed evidence as the literal truth. Yes, the Proclamation did specify that no guineas should pass after 1776 if they weighed less than 5 dwt 8 grs. But, as Allen Simpson states on page 2070, people did not always follow the rules. The trade card on page 2066 proves that people were conservative and went on accepting light coin even though it was technically bullion.
Thomas Williams the scale-maker who worked at 71 Cannon St, and had a second shop at 4 Abchurch Yard after 1817, partly trained William Skinner. A second Thomas Williams, scale-maker, and his successors working under his name, worked at 7 addresses in east central London between 1806 and 1910. But this Thomas Williams only *sold* scales, so was probably a merchant or an ironmonger. Yet another reason for caution!

Basic Library for Americans, Part 1

Paper presented at the New Orleans Convention, 30 May, 1996 By R H WILLARD

Despite the significance of weighing and measuring in nearly every time and place, this subject is largely overlooked in history books. Publications useful to the collector of scales (and weights - they go together) are likely to be rare, out of print, and hard to find. ISASC was formed, in part, to help collectors to share information and research skills with one another.

Scales, in and of themselves, are objects of beauty and balance, rich in symbolism. But even those who begin collecting for purely aesthetic reasons soon want to know more about their treasures. Most of us look first for information about specific items we own or hope to own. "What was this scale used for?" we ask. "How does it work? Who made it? How was it made? When? Where? Is it rare?" And occasionally, rubbing the palms together, "How much is it worth?"

But the answers lead only to more questions! If a scale takes separate weights, what kind would be appropriate: shape? metal? markings? denominations? Or, if the resistant or counterbalance is a sliding poise, spring, pendulum or liquid, how can we tell from the graduations on the beam to what time, place or weight-system the scale belongs and what kind of commodity it was designed to weigh?

Suddenly our horizons have expanded to include the histories of weighing, of technology, and of weight standards as they evolved and spread throughout the world over time, and also the need to become familiar with weight standards of the world's trading nations at a particular time.

Sources of Information to Buy

The information comes in three forms, books, articles, and ephemera (such as catalogues, broadsides and advertisements of scale manufacturers and distributors, auction houses, etc., as well as related newspaper and magazine stories.)

ISASC Library Offerings: Books, catalogues and ephemera

Crawforth, Michael, *Handbook of Old Weighing Instruments*.. $30.00
The most useful single book in print today. Defines and illustrates scale mechanisms and weight forms; contains a wealth of related information useful to collectors. Extends and complements the material in Kisch's Scales and Weights, A Historical Outline (below).

Soslau, Eric and Judy, et al., eds. *Bibliography of Weighing Instruments*......................... $20.00
The world's first and only finding-aid for publications dealing with weighing instruments. (There are many bibliographies concerning weights and measures.)

Sanders, L, *A Short History of Weighing*. Birmingham, England...................................... $18.00
W & T Avery Ltd, 1947, rev. 1960.

Graham, J T, *Scales and Balances / Weights and Measures* (2 vols.)................................ $12.00

See also the specialised titles, scale catalogues and ephemera listed.

Equilibrium articles

Check the EQM Index, available from ISASC, for these categories:
(1) American (approximately 300 entries: scales by type, makers, patentees, companies, US mints and assay offices, etc.)
(2) any other countries of interest

(3) scales by use
(4) scales by mechanism
(5) book, useful
(6) book, reviewed (partial overlap here)
(7) journal, useful
(8) patentee (by nationality).
For EQM articles, order any back issues that appeal to you.

Other books in print

Bueschel, Richard M, *Big Head Lollipop Scales*..$42.50
Fountain Valley CA: Coin-Op Classics Magazine, 1994. Available from W Berning, PO Box 41414, Chicago IL 60641.

Crawforth, M, *Weighing Coins: English Folding Gold Balances of the 18th & 19th C*...........£29
London, Cape Horn Trading Co., 1979. Available from Arthur Middleton, 12 New Row, Covent Garden, London WC2N 4LF, England.

Books out of print

Used and antiquarian book stores are good sources, as are antique and paper goods shows, library-surplus-books sales, estate sales, flea markets, and book-search services (some for a fee). Mail order and auction catalogues of scientific instruments, scales and weights, numismatics, and collectibles frequently offer related literature. For recommended titles, see below.

Ephemera

Try antique, collectible and paper goods shows, garage sales and flea markets.

Sources of Information to photocopy

Photocopies of books and articles that are otherwise unavailable will be among your most useful acquisitions. The examples listed below are for general, basic information. Each book or essay will have its own bibliography listing specialised sources. Always photocopy these lists; they will guide you to the best metrological scholarship in your areas of interest. For lack of space, we did not include such articles in the ISASC Bibliography.

The ISASC Membership Directories

By listing a brief description of each member's collection, these provide a choice of correspondents who may be able and willing to photocopy material in their files for you. Free copies of the ISASC Europe membership directory are available upon request.

The Dictionary

Even small dictionaries have conversion tables of the American and British avoirdupois, troy and apothecary and the international metric systems. Make a photocopy for quick referral.

The Library System

Public and university libraries have the largest selections, but small scientific, business, museum, historical and even genealogical libraries often hold useful material. University libraries usually have the cheapest and most numerous copy machines. Arm yourself with a supply of coins and explore these departments.

The editor apologises to the author and to members for cutting this article in half in such an arbitrary fashion. Part 2 will complete the sources list.